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[OFFICIAL NOTICE.]

June Meeting, Society of Gas Lighting.

OFFICE OF THE SECRETARY, June 2, 1898.

The June meeting of the Society of Gas Lighting will be held in the Engineer's office of the New Haven (Conn.) Gas Light Company, at 1 P.M., of the 9th inst.

FRED. S. BENSON, Secretary.

[OFFICIAL NOTICE.]

Wrinkle Department, Pacific Coast Gas Association.

MERCED, CAL., March 11, 1898.

To the Members of the Pacific Coast Gas Association: At the last meeting of the Pacific Coast Gas Association to me was delegated the duty of collecting and presenting any matter, in the shape of original ideas or special devices, which may come under the head of "Wrinkles," to be presented in proper form for the benefit of the Association at the next regular assembly.

Many of our members having charge of gas plants on the Coast have many plans, that are practical, handy and labor-saving, which many others by force of circumstances have never seen, but who, on presentation of the device, drawn and described, or through the medium of our official organ (the AMERICAN GAS LIGHT JOURNAL), would gladly embrace the opportunity, and put into practice a plan very beneficial—which perhaps had been in use in some obscure place many years, used exclusively by one man—that would, when given daylight, benefit the whole gas fraternity.

On reading this communication, please see if you have not forgotten something in the shape of a "Wrinkle," that is doing good service in your works, that would be of great importance to the Association. Your answer to this will greatly oblige.

GEORGE H. HOLLIDGE,
Editor "Wrinkle" Department.

BRIEFLY TOLD.

THE JUNE MEETING OF THE SOCIETY OF GAS LIGHTING.—Last week we reported that the June meeting of the Society of Gas Lighting would be held in this city, on the afternoon of next Thursday; and now we have to admit that the notification notice was all wrong, save as to the day of the month, which was all right. The "amended" notice puts the place, day and hour in their proper sequence, wherefore it is understood that the meeting will be held in the Engineer's office of the New Haven (Conn.) Gas Light Company, at an early hour of Thursday afternoon. The host will be Mr. F. C. Sherman, whose hospitality has many a time been thoroughly enjoyed by the Society.

PRESIDENT LYNN'S ADDRESS.—A feature of the coming-of-age meeting of the Western Gas Association was the excellent address delivered by its President, Mr. James T. Lynn. A look at his wholesome face, and to listen to his hearty voice, would be enough to convince the casual acquaintance that the best of metal was in Lynn; but those who have known him for a long time may admit to themselves that he has

in him more than they credited to him. At its easiest the preparation of an address for a technical body like that over which Mr. Lynn presided last month is a sufficiently difficult task, for it must be remembered that while critics are many essayists are few; and as a rule the mindful critics always rise superior to the record making writer. And so we think that Mr. Lynn has done more than many, since his message to the Western Association may not be caviled at from a literary standpoint, objected to because it lacks matter of interest, or frowned upon in that it counselled anything not of benefit to the Association or to the industry, both of which he so well represents. His chapters on "Public Lighting" and "Coal Tar" have much in them for thought and commendation, in that everything suggested by him therein can certainly be accomplished. The advocates of "Municipal Ownership" will glean scant encouragement from Mr. Lynn's ringing comment on the falsity of the theories they advance: yet we imagine that the people as a rule and as a whole have about sifted to their satisfaction the grains that the paternalists would sow, only to find that the sieve held nothing but tares. His references to the Association's dead were singularly impressive and fraternal, and glowing with true heat were his remarks in the instance of "Our National Influence." In fact, a careful reading of President Lynn's inaugural message must lead to the conclusion that he knows how to think, and having thought to aptly put his thoughts into speech.

NOTES.—We regret to report the death of Mr. Jonathan Lovejoy Moore, at his home in Laconia, N. H., on the afternoon of May 28th Deceased for many years was Superintendent of the Laconia Gas Light Company, a place that he gave up, in 1887, to engage in the sewing machine trade. Mr. Moore, who was born December 13, 1828, had been a resident of Laconia since 1848, and filled many positions of trust in that city to the entire satisfaction of those whom he represented. The funeral services were held on the afternoon of last Tuesday.——Mr. Chas. J. Goodwin, President and Treasurer of the Chapman Valve Mfg. Company, died at his home in Indian Orchard (a suburb of Springfield, Mass.), on the afternoon of May 27th.——The proprietors of the Peoples Gas Light and Coke Company, of Chicago, Ills., have leased for 10 years, with the right of longer occupancy, the building at the north western corner of Michigan boulevard and Adams street. The building, which is six stories in height, will be remodeled at once.——The consolidation of the gas companies of Pittsburgh and Allegheny, Pa., will be completed by July 1st.——Judge Moer has dissolved the temporary injunction issued at the instance of the authorities of Duluth, Minn., who sought to restrain the Prindle Gas Company from completing its works.——"Observer" says: "The Newburyport (Mass.) Gas Company has had much success in placing gas stoves this season. The Company makes the connection free of charge. The Clinton (Mass.) Gas Light Company has opened a showroom for stoves, etc., in the Morse block. It has also made a special rate on gas used for other than illuminating purposes."——The new proprietors of the Binghamton (N. Y.) Gas Company have filed their information that all of the Compan's possessions are now subject to a mortgage of $750,000.——At the annual meeting of the Atlantic City (N. J.) Company a proposition to reduce the selling rates was adopted. The Directors chosen were: Chas. Evans, J. E. Mehrer, J. B. Champion, J. A. Barstow, J. H. Borton, F. W. Hemsley, Thos. K. Reed, Jno. Roberts, W. L. Elkins, P. A. B Widener, Jas. McNamee, S. Bradley and G. S. Graham.

Some Features Relating to Lighting with Acetylene, with Especial Reference to the Backfiring of Flames.

Victor Berdenich, Engineer at the Budapest (Austria) works, contributed to Schilling's *Journal of Gas Lighting*, etc., of April 30th last, an able, exhaustive and convincing article concerning certain dangerous conditions which form an unavoidable part of any process of lighting with acetylene. The author seems to have charge of a considerable acetylene installation and to be an expert—and a painstaking, honest one—in this comparatively new field. After giving five full pages of interesting details, he concludes as follows:

"I judge, in concluding these my deductions (concerning lighting with acetylene), that the formation of mixtures of air in acetylene pipe lines and generators, even with the greatest care, it seems, cannot be shut out; hence, backfiring of the flames, and consequent arising explosions, are not impossible—on the contrary, are probable."

In addition to the above, he assures the reader that he has fortified himself thoroughly in above views by experiments (his deductions being based on actual occurrences independent of these), and he promises to give in the near future exact data corroborative of his conclusions.—F. E.

[OFFICIAL REPORT.—REVISED BY THE SECRETARY.—Continned from Page 856.]

PROCEEDINGS, TWENTY-FIRST ANNUAL MEETING, WESTERN GAS ASSOCIATION.

HELD AT THE RUSSELL HOUSE, DETROIT, MICH., MAY 18, 19 AND 20, 1898.

FIRST DAY, AFTERNOON SESSION, MAY 18.

The first order of business for the afternoon session was the paper, by Mr. George H. Harper, of Altoona, Pa., on the

ENRICHMENT OF COAL GAS.

The writer does not hope to be able to add anything to the sum of knowledge already existing regarding the enrichment of coal gas, his aim having been rather to collect and summarize the known facts concerning the question, a question which has received considerable attention in recent years, and that will, in all probability, demand closer scrutiny in the near future.

Waiving the question of the value to the consumer of enrichment, which enters directly into the cost of the gas without giving a proportionate increase in light, an effort will be made to describe shortly the different systems of enrichment, and their relative values, that have been devised and used on a commercial scale to accomplish the end in view.

There are four methods of enrichment which conform to the rule of commercial application laid down—carbureted water gas, gas from cannel coal, oil gas and vapors of volatile hydrocarbons. There are other methods which, while of great interest, are not in even limited general use, but of which something will be said subsequently.

Carbureted water gas has been placed first because of its widespread application in this country, its rapid adoption by Europe and the civilized world generally—charitably including China in this latter.

The consideration of carbureted water gas as an enricher is complicated by the fact that, speaking generally, it is produced in such quantities where used as seems to make it doubtful whether enrichment or production is the primary object. It will probably be conceded that, so far as this country is concerned, production rather than enrichment is the aim of the great majority of the installations, enrichment being incidental. If this view be correct, then carbureted water gas as commonly produced provides greater facilities for continuous or intermittent production, instantaneous enrichment at will, the lowest first cost per 1,000 cubic feet capacity, the smallest floor area per 1,000 cubic feet produced, and control of residual and labor markets, than any other process of manufacture with which the writer is acquainted.

Cannel coal has been used for production and enrichment since almost the earliest days of gas lighting; the gas supply of Scotland to day being almost exclusively produced from that mineral. Cannel coal, as used for an enrichment, is distilled in ordinary retorts along with the common coal, the gas from which it is intended to enrich; or in separate retorts set apart, for the duration of the charge or permanently, for that purpose.

The gases mix directly in the retort or hydraulic main, according to the method practiced; or the cannel gas is separately condensed and scrubbed, being mixed with the common or unenriched gas at a point deemed best fitted to secure the object in view. The coke obtained from cannel coal is of small value as fuel and practically worthless as a salable residual. The known area of cannel coal deposits becomes more and more restricted with the years.

Oil Gas.—There are several well-known methods of producing oil gas (Pintsch, Patterson and Keith processes), which do not properly come within the scope of this paper, because their product is generated and employed for special purposes. They will not, therefore, be considered. Other processes might be mentioned, of which the Tatham may suffice as a type, that have been tried, but have failed to find extended use or general recognition.

Of the remaining systems of oil gas enrichment two only need be mentioned; the direct cracking of oils by admission of a regulated stream into ordinary retorts, the resulting gas passing directly to the hydraulic main, to mix with the common gas; and the fractional carbonization of oils by the Peebles process. The former method, of which various modifications might be mentioned, while having an intermittent and more or lesss general application, not a little of such application being of a somewhat makeshift character, has never, in the judgment of the writer, attained to the dignity of a system of enrichment.

The latter process takes its name, not from its patentees (Young & Bell), but from the town of Peebles, in Scotland, where the system was

inaugurated. In this process also a regulated stream of oil is admitted into detached or specially arranged cast iron retorts maintained at a temperature of about 900° C. The resulting gas, instead of passing directly to the hydraulic main, where, under ordinary conditions, its heavier and most valuable light-giving hydrocarbons would be condensed, cut and carried to the tar well, passes into a separate and specially adapted main. The gas then traverses a system of condensing pipes so arranged that the products of condensation flow back to the hydraulic main. The gas is then scrubbed, the scrubbing liquid being the oil intended for subsequent carbonization. The fresh oil, flowing through the scrubber, condenser and hydraulic main, passes to a small supply tank, from which in turn it flows to the retorts, a constant balance being maintained between the quantities of oil entering the re torts and the scrubber. In this way fractional distillation or carbonization is secured by reason of the whole of the condensable hydrocarbons being absorbed or washed out of the gas by the fresh oil with which it comes in contact in the hydraulic main, condenser and scrubber, and repeatedly returned to the retorts for further cracking. As a consequence of the cycle of operations described, the gas leaving the scrubber is composed of only the most stable gaseous hydrocarbons, that will remain gaseous and unimpaired in light giving value at extremely low temperatures.

The very high enrichment value of gas made by the Peebles process from shale oil has led to a considerable number of plants of this description being erected, the daily output from some of which reaches to hundreds of thousands; yet the writer believes the quality and quantity of gas produced prevents the system being considered, like carbureted water gas, at once a means of production and enrichment.

Vapors of Volatile Hydrocarbons.—Of this method of enriching gas, the Maxim-Clark process may be taken as the type; but it is a safe generalization to say that in all the forms of apparatus used a volume of the unenriched gas, proportionate to its bulk and the degree of enrichment desired, is passed through the carbureting vessel, absorbing in its passage the vapor of the liquid hydrocarbon employed; or the required amount of vapor is passed directly into the main stream of gas. In the case of some of these enriching fluids the operation is carried on in the cold; but commonly the enricher is maintained in a state of vapor by steam coils or other means.

This method of enrichment is exceedingly simple and susceptible of very diversified application. It requires the simplest apparatus, and can be readily and easily adjusted to give any increase of candle power desired, within the limit of value of the enriching material used; while the mixture of the unenriched and enriching gases can be made at any point between the retorts and the holder or governor outlet that is considered most advantageous.

The common objective of those diversified modes of enriching coal gas is the production of hydrocarbon gases and vapors of such density and illuminating value that the degree of enrichment desired will be not only secured, but maintained throughout the whole area of supply.

The hydrocarbons with which we are most concerned in the consideration of this subject can be arranged in four groups or families, under general formulas expressive of the several constitutions, thus:

C_nH_{2n+2}	C_nH_{2n}	C_nH_{2n-2}	C_nH_{2n-6}
Methane.	Ethylene.	Acetylene.	Benzine.
CH_4	C_2H_4	C_2H_2	C_6H_6

The above are but the types, or lowest members, of the several series, commonly designated as "light" and "heavy" hydrocarbons; the first or methane group being in the former, and the others in the latter classification. Another definition frequently employed is that of saturated or unsaturated hydrocarbons, according as the combining power of the carbon contained in the molecule is or is not fully utilized. The saturated or methane series, while less valuable as illuminants than the members of the other series, are very stable under a wide range of temperature, and are invaluable as carriers of the heavier or unsaturated type, to which the luminosity of gas is mainly due. The amount of heavy or unsaturated hydrocarbons produced, and retained in the gas distributed, is the measure of the success of any system of producing cannel gas, water gas or oil gas for enrichment purposes.

When it is borne in mind that, under the influence of heat, there can be obtained from methane a mixture of ethylene, acetylene, benzine and even naphthaline, it will be apparent how far-reaching are the effects of conditions of temperature prevailing in retorts for the distillation of cannel coal or oil, as well as carbureters and superheaters, radiant heat rather than contact heat being a dominating factor in the disintegration and reformation of hydrocarbon gases. Herein lies one of the secrets of success in the application of water gas, its light-giving hydrocarbons being produced in an atmosphere of CO and H, which act, not only as carriers, but as preventives of their conversion into other hydrocarbons of less illuminating value, or of greater value but lower stability.

The intrinsic illuminating value of the series of hydrocarbons under consideration may be more forcibly expressed by a comparison of that of their types, calculated to 5 cubic feet.

Methane, CH_4.....	5-candle power.
Ethylene, C_2H_4.....	68 "
Acetylene, C_2H_2.....	240 "
Benzine, C_6H_6.....	700? "

A natural question suggests itself here. Why, with such slight difference in the constitution of some of the molecules, there should be such enormous differences in their illuminating values? Mr. W. Young has, in the judgment of the writer, given a very lucid explanation of the reason. Mr. Young's researches on this point were carried out well-nigh 20 years ago, but have, within very recent times, been corroborated by Prof. Lewes. Mr. Young has pointed out that while ethylene and acetylene have the same weight of carbon in the molecule, or the same carbon density, there are physical and chemical phenomena connected with their formation which have a very marked influence on the light developed in their combustion. The same explanation is applicable to acetylene and benzine, though they contain exactly the same percentage of carbon. The mode of formation, therefore, rather than the percentage of carbon in, or carbon density of, the molecule, would seem to be the chief factor in determining the intrinsic illuminating value of these hydrocarbons.

Since the object is to retain the maximum amount of hydrocarbon gases and vapors in the gas through all the vicissitudes of condensation, scrubbing, storage and distribution, the vapor tension—or that pressure necessary at any given temperature to induce liquefaction—of those gases and vapors is of a very great importance. It has been demonstrated by Young, Lewes and other authorities, that the vapor tension of a mixture of gases of dissimilar vapor tensions will neither be the sum nor the mean of such tension, but a peculiar or special vapor tension resulting from the interaction and mutual solubility of the hydrocarbons upon each other. By virtue of this, hydrocarbons of low boiling point and high vapor tension will unite with and carry the vapors of other hydrocarbons of high boiling point and low vapor tension, which if alone would condense out. When, however, liquefaction of any member or members of the mixture takes place hydrocarbons are carried down which, in the absence of such absorbent, would still be gaseous.

So far we have been mainly concerned with the principles underlying enrichment and the various methods of making these principles effective. In addition to this the writer had hoped to be able to give some figures that would represent the average relative cost of enrichment by the different systems and materials under review, but, owing to the great extent of the country and the greater diversity of materials, labor and general conditions, it is exceedingly difficult to fix upon a point or points, prices or costs which would have any extended or intelligible application. The writer believes that any treatment of this phase of the question, that would be in any sense exhaustive or generally applicable to our diversified conditions, demands not one paper but a series of papers, and much greater time than the writer has had at his disposal.

The following table has been compiled from Brown's Directory of American Gas Companies, for 1894—than which unfortunately there is no later issue. It includes all towns and cities in the United States and Canada of 5,000 or greater population, for which returns are given; but is exclusive of places producing oil gas, or where some purely local or little known type of apparatus is employed. Whatever error there may be in these figures, when applied to existing conditions, will almost certainly be of the nature of an understatement of the percentage of water gas. This may be offset to some extent by "process" being returned as "Coal and Lowe," etc., but where coal gas alone is manufactured and supplied. The writer feels sure, however, that the direct increase in the installations of water gas plants since 1894 will greatly outnumber those thrown into disuse in the same period.

	No. of Towns.	Per Cent. of Total.	Total Output.	Per Cent. of Total.	Average Candle Power.
Coal gas.....	362	48.4	7,979,250,000	15.60	17.99
Coal and water gas	88	11.8	17,227,000,000	33.60	21.42
Water gas.....	298	39.8	26,016,500,000	50.80	23.22
	748	100.0	51,222,750,000	100.00	

The writer believes it is fair to assume that at least 60 per cent. of the output under coal and water gas is water gas. This gives us 70.53 per cent. of the total output shown as water gas. Nor will it be unfair to assume further that the total output of gas in towns under 5,000 popu-

lation will approximate to 320,000,000 cubic feet, and that 42 per cent. of it is water gas.

In the light of these figures the writer believes he is warranted in saying that at least 71 per cent. of all the gas distributed and sold in the United States and Canada is carbureted water gas. It follows, then, that for the above percentage of all the gas manufactured and sold in America and Canada the question of enrichment is already settled. Nor is the extent of enrichment an important factor financially, since labor and fixed charges will remain the same for any degree of enrichment, the oil account alone being affected.

The table shows that almost one half the total number of towns and cities of 5,000 or greater population are supplied with coal gas only; and it may be safely assumed that a like percentage of the towns under the 5,000 mark are similarly supplied. To this extent the question of enrichment may be of interest.

From the average candle power given for coal gas, it may be inferred that the desired enrichment will not exceed one to two candles; and, owing to the general financial and other conditions of a large number of the smaller companies and works, it will be sought to accomplish this in the most economic and convenient way possible.

Having already described the different systems of enrichment and their operation, let the following tabulated statement suffice to show, apparently, the practical results obtained from them. Cannel gas has been omitted because of the great curtailment of the supplies of first class cannel, and the results obtained from many varieties in use being too widely separated to give any figures of general interest or value.

Candle power of unenriched gas..... 16
Desired candle power..... 18

Water Gas.		Oil Gas (Peebles Process.)		Hydrocarbon Vapors. 1 Candle by 1 Gallon.	
Candle power or photometric value of water gas.	23.00	Candle power or photometric value.....	60.00	Benzol (pure)..	11,081 c.f.
Enrichment value.....	33.35	Enrichment value.....	90.00	" 90 pr. ct..	10,415 "
Gallons of oil per 1,000 cubic feet sp. gr.....	4.07	Yield of gas from 1 gallon of oil.....	85c.f.	Curburine sp. gr. .680	4,749 "
Candles per gallon on photometric basis.....	1,130	Gallons of oil per 1,000 cu. ft., sp. gr. 850.....	14 08	Petroleum sp. gr. .700.....	3,583 "
Candles per gallon, on enrichment basis.....	1,639	Candles per gallon on photometric basis.....	852		
Percentages of mixture on photometric basis.		Candles per gallon on enrichment basis.....	1,278		
Water gas....	28.57	Percentages of mixture on photometric basis—			
Coal gas.....	71.43	Oil gas.....	4.55		
Percentage of mixture on enrichment basis—		Coal gas.....	95.45		
Water gas....	11.57	Percentages of mixture on enrichment basis—			
Coal gas.....	88.43	Oil gas.....	2.70		
		Coal gas.....	97.30		

It may be well to explain that the distinction made between photometric and enriching values is based upon the fact that when water gas of given candle power or photometric value is mixed with coal gas of known candle power, the candle power of the mixture is in excess of that theoretically required by the percentage composition of the mixture. The same is true of any mixture of oil and coal gas, or of different qualities of coal gas. The late Mr. John Methven, of London, England, stated—*Journal of Gas Lighting*. vol. 67, p. 1164—that during six months' working at Beckton, in 1895, the photometric value of their purified water gas gave 1,259 candles per gallon per 1,000 cubic feet, but the illuminating value of this gas, when mixed with a coal gas of known candle power, gave to the water gas a value of 1,827 candles per gallon per 1,000 cubic feet, or an increase of over 45 per cent. This gives a factor of 1.45, by which the observed candle power should be multiplied in order to arrive at the true illuminating value. Within what range of photometric values this law or deduction is applicable has not been determined.

It has been shown the part that carbureted water gas plays in the gas production of this country; and it may be dismissed once for all as being the cheapest, simplest and most generally applicable mode of enrichment, combined with productive capacity, of which the writer has any knowledge.

Oil gas on the lines of the Peebles process has not, so far as the writer is aware, been tried in America; while there are doubtless numerous places where oil is being used in ordinary retorts.

Of the hydrocarbon vapors the writer believes that benzol is among the best small scale enrichers that can be employed. Its enriching power, as compared with some of the paraffine distillates, is shown by the table. These figures (T. Stenhouse, *J. G. L.*, vol. 66, p. 142) have been selected from a number of widely differing statements by different observers, because of the great care exercised in the experiments upon which they are based; and also because they have been confirmed by more than one well-known gas engineer from practical working.

Enrichment by benzol is permanent over a wide range of temperature, as shown by the following table, compiled by Dr. Bunte, *J.G.L.*, vol. 63, p. 485.

Temperature.	Vapor Tension in Mm. Mercury.	Percentage of Vapor by Volume.	Grammes of Benzol in 1 Cu. Meter.	Difference.
— 20° C.	5.79	0.76	26.50	....
— 15° C.	8.82	1.17	40.40	13.9
— 10° C.	12 92	1.70	59.30	18.9
— 5° C.	18.33	2.41	84.00	24.7
— 0° C.	25.31	3.33	116.10	32.1

It will be observed that at the freezing point benzol has a vapor tension of 25.31 mm., or 1 inch of mercury, and that gas will safely carry 3.33 per cent. by volume at that temperature. While there are numerous instances where benzol is depended on entirely for large scale enrichment, it cannot be said to have obtained very wide recognition. This may arise, to some extent, from the great and perplexing fluctuations in the price of benzol, which have been common in recent years. Since coal tar is the great commercial source of benzol, it seems not unreasonable to expect that, with the ever increasing number of bye-product coke ovens being put in operation, and consequent excessive production of tar, a portion of this over-production may provide a steady and reliable supply of benzol at low prices.

Of systems or means of enrichment other than those dealt with, only two will be mentioned—acetylene and tar; the former because of the great interest attaching to it, and the latter on account of its latent possibilities.

Enrichment of coal gas being the subject matter of the paper, the writer will say at once that, in his judgment, the brilliant researches of Mr. W. Young and Prof. Lewes prevent any consideration being given to acetylene for that purpose. No attempt will be made, therefore, to add to or try to reconcile the widely diverging opinions and figures relative to the cost of producing calcium carbide.

It has been shown that, when burned alone, acetylene has a calculated illuminating value of from 213 to 240 candles, but it does not maintain a proportionate enrichment value when mixed with diluent gases. The following table, taken from a paper read by Prof. Lewes at a meeting of the Incorporated Institution of Gas Engineers, *J. G. L.*, vol. 65, p. 1,067, shows the relative percentage of coal gas and acetylene required to produce a given candle power:

Percentage Composition of Mixture.		Illuminating Value.		Enrichment Value of 1 per Cent. in Candles.
Coal Gas.	Acetylene.	Coal Gas.	Mixture.	
99.10	0.90	13	13.9	1.00
97.90	2.10	13	15.1	1.00
96.00	4.00	13	17.3	1.07
95.20	4.80	13	18.4	1.12
91.00	9.00	13	23.5	1.16
89.50	10.50	13	25.3	1.17
85.00	15.00	13	33.0	1.33
83.25	16.75	13	36.1	1.36
66 90	33.10	13	60.5	1.43
55.50	44.50	13	76.7	1.43
16.70	83.30	13	175.2	1.94
00.00	100.00	13	240.0	2.40

Prof. Lewes has demonstrated very clearly that acetylene being an endothermic body, its great luminosity is due to thermo chemical reactions taking place in the flame, with the sudden liberation of the energy rendered latent in its formation and the instantaneous heating, to a high degree of temperature, of the carbon liberated in the decomposition of the molecule. It has been shown further that the luminosity is independent of the percentage of acetylene in the gas, but dependent on the amount found at the commencement of luminosity in the flame. It is readily apparent now why there should be a decrease in the proportionate value of enrichment with an increase of dilution, as shown by the table. Indeed, Prof. Lewes has shown that, in order to decom-

pose the acetylene molecule with evolution of light, for every 10 per cent. of dilution the flame temperature must be raised 100° C.

No percentage of acetylene added to uncarbureted water gas will produce a luminous flame; and, since over 71 per cent. of all the gas produced in this country is water gas, it appears to the writer that acetylene has a limited and lessening field, so far as central station lighting is concerned.

But a few years ago the only experiments that had been made in the carbonization of tar—and those somewhat discredited—were with the Dinsmore process, at Widnes, England. Since then several successful attempts have been made to utilize tar for the production and enrichment of gas.

Mr. C. Stafford Ellery, in a paper read before the Incorporated Gas Institute—*J. G. L.*, vol 64, p. 25—states that 16,000 cubic feet of candle power gas can be obtained per ton of average tar carbonized. Mr. Isaac Carr—than whom no one has had greater experience in this line—in discussing this paper says that tar from ordinary Durham and Northumberland coal can be made to give a much higher illuminating value than 15 candles. All the enrichment necessary to supply an 18-candle power gas in Widnes is obtained from tar. Mr. Bell—*J. G. L.*, vol. 62, p. 264—gives 15,000 cubic feet of 25.2 candle power gas yielded by tar from Scotch coal by the Peebles process. In 1894 Mr. Young secured a patent for a form of apparatus one of the special merits of which is its ability to produce illuminating gas from crude coal tar.

It would be impossible to close a paper on the enrichment of coal gas without referring to the question whether or not enrichment of coal gas is necessary or desirable; and if necessary or desirable what the degree of enrichment should be in any particular or general set of conditions. In any consideration of this aspect of the question it is important to keep in mind that a very large proportion of the gas sold to-day is used for purposes other than lighting, for which uses the calorific, rather than the photometric, value of the gas is the criterion of its usefulness; and that an increasing amount of that used for lighting is consumed by appliances in which the illuminating value of the gas, as understood by the photometer, is of small moment. Again, if enrichment is deemed necessary, will not its value to the consumer be measured by its permanence? If a given candle power, the result of enrichment, obtained at the gas works or other testing station, is not maintained throughout the entire area of supply, wherein lies the special necessity or value of such enrichment? To put it another way. If we purchase a yard of broadcloth do we not expect and demand that it shall meet the requirements of a standard yard, wherever measured?

Another point of vital importance is the great difference between the conditions governing the burner by which the illuminating value of the gas is usually determined and those by which it is very largely consumed. The following table will illustrate this point:

Burner.		Candle Units of the 16 candle Gas Consumed.
Regenerative		10.00 per cubic foot.
Standard Argand		3.20 " "
Ordinary Argand		2.90 " "
Flat flame	No. 7	2.44 " "
"	No. 6	2.15 " "
"	No. 5	1.87 " "
"	No. 4	1.74 " "
"	No. 3	1.63 " "
"	No. 2	1.22 " "
"	No. 1	0.85 " "
"	No. 0	0.59 " "

Assuming a proportionate loss with an enriched gas, it hardly seems as if the consumer would be greatly appreciative of, or benefited by, enrichment.

This, however, is only one source of trouble. The candle power, as determined by the photometer, is a varying quantity with a given gas, according to the burner used. However exact the science of photometery may be in the abstract, in the concrete and under general conditions it is not reliable, unless we can evolve a fixed and unalterable code of conditions governing its application. As it is one set of experimenters declare that "common gas"—a somewhat elastic phrase by the way—should be tested by the standard Argand burner under standard conditions, and that rich gases, of 20 candles or over, must be tested by a flat flame burner, "best suited for the particular quality of gas being tested." Another set of authorities insist with equal force that all determinations of candle power, whatever the quality of the gas, should be made by the standard Argand. Then, again, shall we burn the gas at the prescribed rate of 5 cubic feet per hour, or a greater or less rate, according to the assumed quality of the gas and the prejudice of the operator.

Prof. Lewes—*J. G. L.*, vol. 65, p. 1,068—defines illuminating value thus: "A considerable amount of vagueness exists as to what is meant by the illuminating value of a gas; and the only assumption which can be arrived at is that it is the highest illuminating effect which can be produced from the gas without the aid of regeneration or artificial air supply other than that created by the flame itself. The proper combustion of any hydrocarbon gas, however rich, can be effected by supplying the flame with exactly the amount of air necessary to prevent smoking; and it is under these conditions that the highest illuminating effect possible with the particular burner is obtained."

The writer is not quite certain whether in his own case this explanation has increased or diminished the previously existing "amount of vagueness." Would it be correct to say that the gas yielding value of a ton of coal is measured by the amount obtained when the coal is carbonized without the application of regenerative appliances?

The Deadly Parallel.

A. C. HUMPHREYS.

J. G. L., vol. 66, p. 1087.

As a matter of commercial fairness it would seem as if the comparison should be made with the gases burned in each case in a way which the consumers could easily, simply, and economically employ, and would, under those conditions, give each gas so burned the greatest possible efficiency. This would seem to point to the general use, for testing, of high grade, though cheap, flat-flame burners.

GAS PHOTOMETRY.

J. G. L., Vol. 68, p. 117.

Then as regards that highly important piece of apparatus, the gas burner; there is now no need to argue for the Argand pattern for photometrical use. It is employed without exception for ordinary coal gas. What is now needed is to systematize the Argand pattern, as adapted to the different grades of gas supplied in various parts of the country, so that there shall be a burner of this kind available for every district which will burn the local gas at the full statutory rate of 5 cubic feet per hour without giving the operator any trouble.

Thus in at least one respect would order supersede chaos in gas photometry.

PROF. LEWES.

J. G. L., Vol. 68, p. 1070.

While admitting the usefulness of photometric observations on the horizontal plane, as giving a basis for legislative enactments as to the equality of an illuminating gas supplied to a town, I think the time has now arrived for a more general recognition of the fact that the values so obtained are useless for giving any indication of the light which a consumer may expect to develop from it. The so called 16-candle coal gas supplied to London is made to yield on the horizontal plane anything from 8 to 80 candles of illumination, according to the burner used for its consumption.

T. NEWBIGGING.

J. G. L., Vol. 63, p. 1,221.

The fact is that, for all, or most, qualities of coal gas, there is but little variation in illuminating effect in using the flat flame burner. The physical conditions under which the flat flame burner is sometimes used, rather than the chemical conditions of the gas, will generally account for any lack there may be of illuminating effect. But I know from experience that it is a fallacy to say that the flame burner gives under test a higher value than the Argand with 20-candle gas and upwards.

CHAS. HUNT.

J. G. L., Vol. 70, p. 687.

Had my experiments been made by irrational method (not infrequently pursued) of adhering to the 5 cubic feet rate of consumption, my results would have varied from the figures given up to a value of about four times as much—depending upon the quality of the unenriched gas and the extent of the enrichment. The standard Argand burner, as I have many times pointed out, greatly depreciates the quality of a poor gas when it is consumed at the five cubic feet rate; and consequently the poorer the unenriched gas so tested, the greater the apparent value of the enriched. Indeed it is as easy to show that an enricher possesses no enriching value at all, as it is to show that it possesses many times its true value, if unsuitable burners be selected for testing either the unenriched or the enriched gas.

In conclusion, it will be endeavored to show, by means of the "deadly parallel" that the questions of enrichment, the relative value of enrichers, and the value of enrichment to the consumer, so far as these are determined by existing photometric methods, are in a somewhat chaotic condition. (See "deadly parallel" on preceding page.)

Discussion.

The President—Mr. W. W. Goodwin, of Philadelphia, has prepared a written contribution to the discussion on this very interesting paper by Mr. Harper. I will ask Capt. White to read the contribution of Mr. Goodwin, after which the discussion can be proceeded with in regular manner.

Captain White read as follows:

Mr. President and Members of the Western Gas Association—At your annual meeting held at Chattanooga two years ago, it was my privilege to present and read to you a paper setting forth the results of a number of tests that I had made to determine the enriching qualities of acetylene (produced from carbide of calcium) when used for the purpose of increasing the candle power of gas.

A short time ago your Secretary, Mr. Dunbar, wrote me, stating that Mr. Harper was to read a paper on the enrichment of coal gas, and requested me, if possible, to be present at this meeting and take part in the discussion, in the direction of my tests, as to the enriching qualities of acetylene for that purpose. I replied that, owing to my unfortunate physical condition, I would not like to trust myself in an offhand discussion, but if he thought it would be agreeable to the Association I would prepare and exhibit a graphic diagram accompanied with a short paper setting forth and explaining the results of my tests. Receiving a reply that this would be agreeable, I have the pleasure of exhibiting to you a diagram, which I compiled, after having made at least 1,000 tests, in order to try to determine what per cent. of acetylene would give the best results with a gas of from 14 to 16 candle power. After many experiments I finally selected mixtures which contained 4, 6, 8 and 10 per cent. of their volume of acetylene; the candle power was taken each and every time, and each mixture was divided into 10 observations for candle power, the average of these tests being used to construct the diagram. The specific gravity of the gas was also taken, before and after enriching.

For the purpose of making these tests, I improvised a photometer room, in which I placed a 60-inch bar photometer, using for the determination two standard sperm candles, each consuming at the rate of 120 grains per hour. The burners used were Peeble's flat-flame, governor pattern, adjusted to consume 5 feet per hour, under ½-inch pressure, and a Sugg's D Argand, consuming 5 feet, with a 7-inch chimney and 3-inch flame.

For the purpose of making these tests, I also designed and constructed a generator made of steel pipe, 12 inches in diameter, and about 3 feet high. Within this pipe I placed another pipe, 8 inches in diameter, of sufficient length to protrude through the top. The outside tube was capped at the bottom, also at the top; the inside tube was also capped at bottom, in which two valves were placed (kept closed by springs); one valve was connected by a rod placed between the outside and inner tube and projected through the top cap, so it could be operated by a special arrangement to admit the necessary water through this valve into the inside tube, the annular space between the tubes being filled previously with water by a connection to the water pipe. On the outside was fitted a glass tube similar in arrangement to that of a water line gauge of a station meter. Other appliances were connected to the generator, such as a governor to shut off the water when the pressure reached a certain point. A cap was fitted to a lead joint seat, a cotter bar and screw being arranged to secure the cap or lid in place, exactly in principle to the mode for securing retort lids to mouthpieces. The second valve in the bottom of the inside pipe was adjusted to open outwards when the pressure reached a point I had adjusted it to, the object being to force the water back into the outside tube. At the same time the governor attached to the rod used to admit the water operated upon a sleeve, whereby the pressure was removed from the inlet water valve, and which would close by the action of a spring, thus shutting off the inflow of water, and, as stated, the pressure generated in the inner tube would drive the water away from the carbide. By this and other appliances I had complete control of the generator and was enabled to see or tell exactly what was taking place within the same, and thereby prevent accidents. I designed a special form of cartridge, made of tin, arranged so that the water must enter through a central hole in the bottom. These cartridges held from 5 to 10 pounds of carbide of calcium.

After placing the cartridge in the generator, it was sealed up by placing the cap over the top, which was secured in place by the cotter bar, as already stated. Then, by turning a wheel on top of the rod already referred to, the valve would be forced open, admitting water from the bottom of the generator, which, rising within the center tube and reaching the bottom of the carbide cartridge, gas would be instantly generated, and by the governor arrangement the flow of the water was shut off when a steam spring gauge recorded the proper pressure within the generator, which, while designed to withstand over 200 pounds with safety, was not allowed to exceed 10 to 15 pounds. This generator was connected to two 5 foot gasholders or provers, laid off so I could measure 5 feet or $\frac{1}{100}$ of 1 foot. I erected two rows of ¾-inch pipe, each fitted with one dozen burner cocks surmounted with 5-foot burners, making two dozen in all. This row was connected to the gas main of the room, as well as to the provers, in such manner that any part could be shut off, by-passed, or gas sent to the photometer.

The mode of procedure in making a test was as follows: Five pounds of carbide was weighed and placed in the cartridge; this was then placed in the generator and the water valve referred to was then opened. The moment the water reached the carbide through the hole in the bottom of the cartridge, acetylene gas was generated, which was shown by the rise of the mercury in a siphon gauge, capable of indicating about 6 pounds. The governor was adjusted to shut off the water when the pressure reached 5 pounds. Frequently the moisture in the cartridge would continue to generate gas until the pressure indicated 10 pounds, and the gas so made was held in the generator until desired to be used.

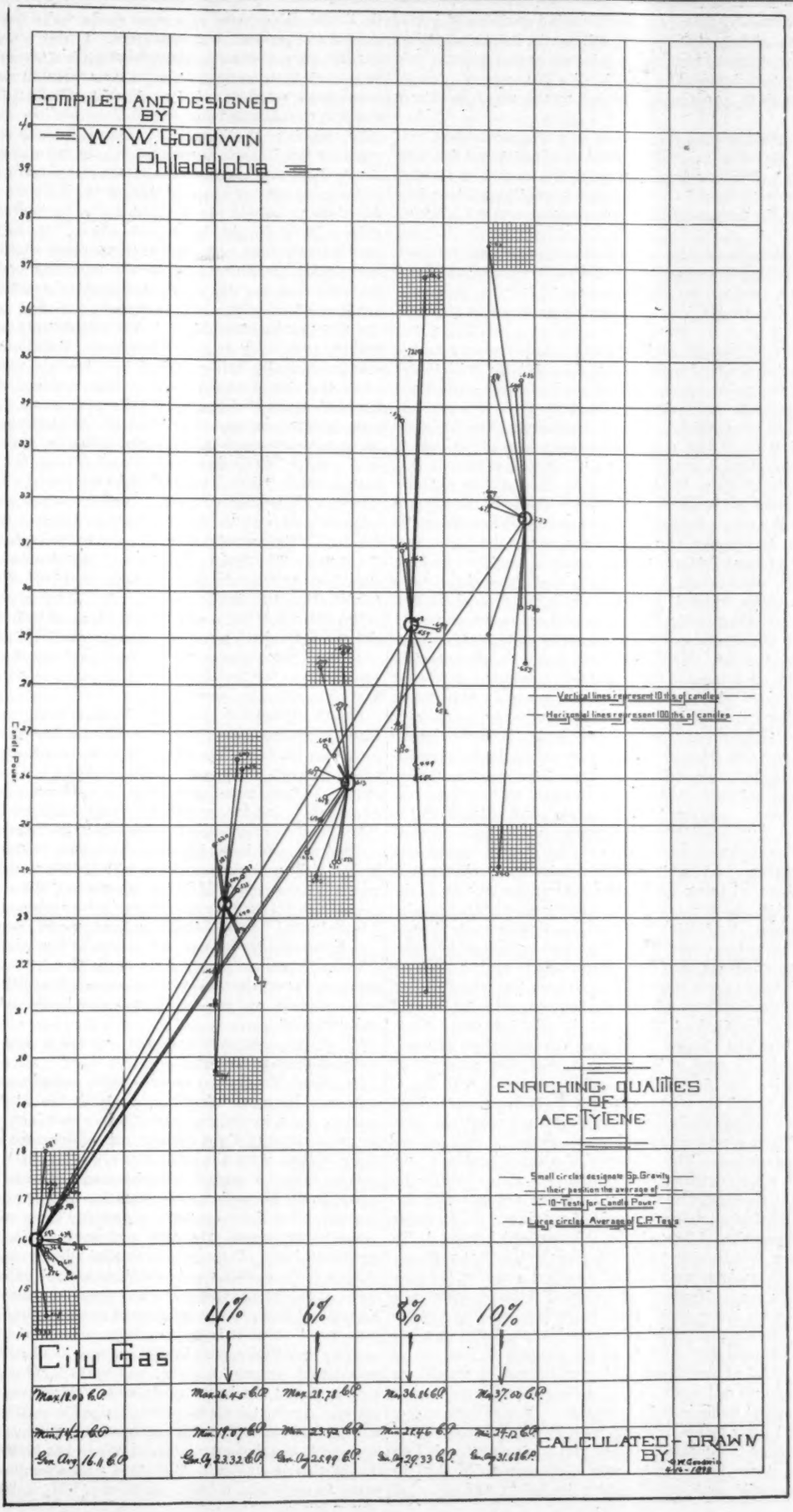
The city gas would then be admitted into the holder in such quantity that, when the acetylene was introduced into the holder, the mixture would equal either 4, 6, 8 or 10 per cent. of acetylene, of the *volume*. To show the effect of the mixture of acetylene upon the gas, the city gas would then be turned into the two rows of burners and lighted; after they had burned several minutes, by an arrangement of cocks the city gas could be turned off and the mixture from the holder made to follow instantly and without extinguishing the burners. A few seconds thereafter the remaining city gas in the pipes would be pushed along and consumed, followed by the mixture, and the same reaching the burners would instantly show itself by the *increase* of the light, and each burner would follow after the other like a wave; then the operation would be reversed, by shutting off the mixture, and city gas turned on, and would follow the remaining mixture, and the city gas, reaching the burner, would *lower* the light of each burner, *as they had been increased*, when the mixture had reached the burner. The effect has to be seen to be fully realized. Then the photometrical power of the city gas would be determined by 10 observations followed by the mixtures. It is to the *average* of these photometrical tests I will now call your attention. The diagram shows the average of 140 photometrical tests of unmixed or city gas, the lowest 10 observations showing 14.21-candle power, and the highest, 18.03-candle power, the average of the 140 observations being 16.18-candle power, as is indicated on the diagram at this point. Then follow the photometrical test of 130 four per cent. mixtures, which gave a minimum of 19.70-candle power and a maximum of 26.45-candle power, and an average of the 130 observations of 23.28 candle power, as indicated in the diagram. The minimum of 130 six per cent. mixtures gave 17.56-candle power and a maximum of 28.75-candle power, and an average of the 130 observations of 27.56-candle power.

The minimum of 140 eight per cent. mixtures gave 21.46 candle power, and a maximum of 36.86 candle power, and an average of the 140 observations of 28.84 candle power. The minimum of 100 ten per cent. mixtures gave 24.10 candle power, and a maximum of 37.50 candle power, and an average of the 100 observations of 31.59 candle power.

The small spots on the diagram at the end of the lines indicate the *average* of ten tests made at the time of record; therefore, by taking the average of all the tests made we find the same to equal the average candle power, and its location on the diagram, which you see is divided into equal squares, which are also subdivided into tenths, each vertical division representing one-tenth of a candle and the horizontal division one-hundredth. We are, therefore, enabled to plot out and present to you a graphic view of the effect of the addition of the several per cents of acetylene to the gas. At the end of the line will also be found the specific gravity of the gas before and after the mixture was made.

In a recapitulation of these tests and mixtures we have the following as the increase of candle power and their per cents. Taking the city averages of 16.18 candle power as the unit, we have:

Mixtures per Cent.	City Gas and Increase by Mixtures.	Increase in Candle Power.		Per Cent. Increase in Candle Power.	Difference between 4, 6, 8 and 10 per Cent. Mixtures.
4	23.46	7.28	=	44.90	....
6	27.56	11.38	=	70.30	25.40
8	28.84	12.66	=	78.20	33.30
10	31.59	15.41	=	95.20	50.30


COMPILED AND DESIGNED BY
W. W. GOODWIN
Philadelphia
Candle Power
Vertical lines represent 10 ths of candles
Horizontal lines represent 100 ths of candles
ENRICHING QUALITIES OF ACETYLENE
Small circles designate Sp. Gravity their position the average of 10 Tests for Candle Power
Large circles Average of C.P. Tests
4%
6%
8%
10%
City Gas
Max 18.09 C.P.
Min 14.21 C.P.
Gen. Avg. 16.11 C.P.
Max 26.45 C.P.
Min 19.07 C.P.
Gen. Av 23.32 C.P.
Max 28.78 C.P.
Min 23.92 C.P.
Gen. Av 25.99 C.P.
Max 36.16 C.P.
Min 27.46 C.P.
Gen. Av 29.33 C.P.
Max 37.60 C.P.
Min 27.10 C.P.
Gen. Av 31.18 C.P.
CALCULATED - DRAWN BY

Having demonstrated by these tests the enriching qualities of acetylene produced from carbide of calcium, I will say in conclusion that I have had an opportunity to examine the drawings of an apparatus and description of a system, designed by Prof. Vivian B. Lewes, of London, whereby a low grade of gas can be enriched by the use of carbide of calcium.

It seems to me that this raises the subject to a commercial one, viz., at what price can carbide of calcium be produced or purchased to enable its use in this way? That question I am unable to answer, my contribution being intended to treat only with the matter of quantities necessary to be used for the purposes under consideration and not a matter of cost.

I trust I have been able, by this contribution, to add some information to the subject of enrichment of gas in this, until recently, unknown direction. I thank you for your kind attention.

The President—I think Mr. Miller has something to say on this subject.

Mr. A. S. Miller—I was requested to prepare some remarks on this paper, but on reading it over I must confess I cound not understand what the author intended to prove. He has made a great many statements, but apparently no conclusion has been reached, and no data have been furnished from which to draw a conclusion. The first statement upon which I would like some information is made on page 9, and refers to the enriching power of water gas. My experience is that the enriching power of 23 to 25 candle power water gas is not any greater than the water gas itself; but the candle power of the mixture of coal gas and water gas, provided the water gas is not over 30 candle power, figures out the average of the coal gas and water gas. Perhaps that is not very clear. What I mean to say is that the resulting candle power is the mean candle power of the coal gas and the water gas, provided the candle power of the water gas is not over 30 candles. I would like to know whether Mr. Harper made those experiments, and whether he is sure of the results. There is another statement, on page 12, to which I wish to refer. Mr. Harper says that "No percentage of acetylene added to uncarbureted water gas will produce a luminous flame." I do not know whether this is true, but it seems a remarkable statement, and I hope that Mr. Harper has good authority for making it. Then, on page 13, he says, "Again, if enrichment is deemed necessary, will not its value to the consumer be measured by its permanence?" I suppose that goes without saying. I do not see why we should think of any enrichment that does not afford an enrichment at the consumer's burner. On page 14, Mr. Harper gives a table, at the end of which he says, "Assuming a proportionate loss with an enriched gas, it hardly seems as if the consumer would be greatly appreciative of or benefited by an enrichment." That is a point to which I would like to take exception. I think Mr. Harper knows, just as well as the rest of us, that a high candle power gas (a water gas, which is the principal gas in this country) will give a higher candle power per foot if burned in flat flame burners than it will if burned in Argand burners. Therefore, the whole assumption is entirely unfair and against the high grade gas. In addition to that there will be no such loss with the high grade gas. Taking No. 6 as the standard in the figures quoted, No. 5 would be only 87 per cent. of No. 6; No. 4, 81 per cent.; No. 3, 76 per cent.; No. 2, 57 per cent. Fortunately I happen to have at hand some tests of burners that I have made. I used a No. 6 burner, and that gave out 29 candles. Comparing No. 5 with it, I got 99.4 per cent.; with No. 4, 93.6 per cent.; No. 3, 83.7 per cent.; with No. 2, 71.2 per cent. That seems to me to be a very powerful argument, right at the start, in favor of enrichment. There is no such loss of candle power in enriched gas as there is in unenriched. The efficiency of a small burner is very much higher with a high candle power gas than it is with a low candle power gas. On the same page he says: "Another set of authorities insist with equal force that all determinations of candle power, whatever the quality of the gas, should be made by the standard Argand." To that statement I say that those are not authorities in the United States. The tendency of the paper seems to reflect upon the action of the photometer as an instrument. None of us claims that the photometer is perfect, and all of us know there must be certain conditions under which it works. The standard of length in the United States is a bar of metal; and it is known that only at one temperature is that bar at the proper length. All of our measures of quantity and of weight, as well as all our measures of length, depend upon that standard, which is itself variable, except under certain conditions. We cannot expect our photometer to be any better or more reliable than that specification. I do not pretend to say for an instant that it is as good, but I do say that, where a dozen honest men, who have reasonable skill in handling the photometer, and who honestly intend to find out what the illuminating power of a given gas is, make the test, they will not vary over 1 per cent. from the mean. I think it is a pity to let a paper like this go out before the world—which is always ready to criticise gas people and their methods—and let them feel that we do not have confidence in our methods. I, for one, wish to state I have absolute confidence in the photometer.

Mr. Jenkins—While what I would say has no connection with the paper by Mr. Harper, it has a bearing on the matter submitted by Mr. Goodwin, in that my story is related to a use of acetylene gas. Some two months ago the agent of one of the acetylene gas companies induced the trustees of one of the churches in Buffalo to put in a machine. It did not give much satisfaction. In fact they had trouble with it all the time, and within less than one month the machine was taken out of the church, despite the slick talk of the promoter, who promised each day that the lighting service would improve constantly as the people in charge became better acquainted with the method of working the machine. The cost was considerably more than that of the coal gas previously used for illuminating the church, and the burners were continually being choked up. In fact, almost every evening when the church was lighted at least a dozen of the burners were found choked up. I had agreed to supply the church with gas at any time upon two or three hours' notice. At noontime one Saturday they asked us to prepare to light the church that evening, and I sent our men with a meter, which was connected up at once, but we found we could not give them gas to practically light the church. It took three days' hard work to get our coal gas through the pipes in that church, and I have here some of the deposit which we removed from them. This (indicating) is the material that came out of the pipes, which you will notice is not unlike lime in appearance. In some places the pipes were choked up almost entirely. The lime was hard. How it got there after being put into the gas I cannot tell you. I thought this might be interesting to some of those who talk of using carbide of calcium as an enricher. I think if you look at this you will find something enabling you, when you go home, to convince your consumers inclined to try acetylene gas for illumination that it would be about as well for them to stick to ordinary commercial gas.

Mr. D. McDonald—Does Mr. Harper really intend the statement that "No percentage of acetylene added to uncarbureted water gas will produce a luminous flame?" If that is true then it follows that a very small percentage of uncarbureted water gas added to acetylene will render the flame non-luminous or blue. Such a thing would be most remarkable; but for my part I do not believe it.

Mr. Doty—The statement referred to by Mr. McDonald I confess also startled me, and I also intended to ask Mr. Harper the question raised by Mr. Miller. In conversation with Mr. Harper, and after carefully re-reading the paper, I find the answer has already been suggested in the paper itself; for, by referring to paragraph on page 12 of the paper, it is said that, "Prof. Lewes has demonstrated very clearly that acetylene being an endothermic body, its great luminosity is due to thermochemical reactions taking place in the flame;" or that the flame temperature of uncarbureted water gas was not sufficiently high to decompose acetylene, and raise the particles of hydrocarbons in acetylene to incandescence.

Mr. Miller—Uncarbureted water gas has a very much higher flame temperature than coal gas.

Dr. Moss—Mr. Harper starts out with a statement that I do not quite approve. He says, "It will probably be conceded that, so far as this country is concerned, production rather than enrichment is the aim of the great majority of the installations, enrichment being incidental." I think if that were the case water gas might be made very much cheaper than it is now. That idea seems to me to run throughout the whole of Mr. Harper's paper—that illuminating power does not matter so much—that if you can get the quantity it does not matter about the illuminating power. On page 5 he says, "A natural question suggests itself here. Why, with such slight difference in the constitutions of some of the molecules, should there be such enormous differences in their illuminating values?" He goes on then to tell us what Mr. Young and Prof. Lewes (who are of course authorities) say on the subject; but I think it is easy enough understood why there should be such a great difference. In the complete combustion of CH_4 we get a considerable amount of watery vapor which reduces the temperature of the flame, and consequently does not give us very much illuminating power. Again, taking ethylene; instead of getting anywhere near so much water vapor from its combustion we get considerable more carbonic acid, and that extra atom of carbon has far greater ratio power in that particular place with C_2H_4 (and with a smaller amount of watery vapor formed) than it has in the form of CH_4, or methane. Again, on

page 9 he says, "But the illuminating value of this gas when mixed with a coal gas of known candle power gave to the water gas a value of 1,827 candles per gallon per 1,000 cubic feet, or an increase of over 45 per cent. This gives a factor of 1.45, by which the observed candle power should be multiplied in order to arrive at the true illuminating value." That factor will not work out in any other case. That is to say, they change continually, and one cannot work with any factor and call it a correct one, because if you work on different amounts, however slight they may vary, the factor will vary to a much greater extent than in the amounts in the two gases. Another point is one which Mr. Miller well brought out with respect to the calculation of the illuminating power by the photometer. If a standard is laid down at a certain temperature and a certain rate, and every precaution is taken, I believe that with competent operators, if a dozen people were to make the same tests, they would not vary a half per cent. On page 12 Mr. Harper says, "Prof. Lewes has demonstrated very clearly that acetylene being an endothermic body, its great luminosity is due to thermo-chemical reactions." Of course it is an endothermic body to a considerable extent, but if we have carbon particles present we must get some illuminating effect from the carbon particles, else what is the use of having any carbon at all? Why not use the Welsbach burners and have no hydrocarbon whatever? We must get some illuminating effect from the carbon He rather means here, in my opinion, that the endothermic effect of the acetylene is due to the great intensity with which it unites with oxygen, and consequently calls it an endothermic body. With regard to the "Deadly Parallel," and respecting what Mr. A. C. Humphreys said, I may say that the test of any gas naturally turns on its highest efficiency; and it does not matter, so far as I can see, whether a consumer is so careless that he will not listen to reason, or take advice from gas engineers, as to the kind of burner best suited for the particular gas he is using if he wastes that gas or fails to secure its highest illuminating effect or power, call it what you will, so that the gas consumed is not equal in its illuminating effect to that which is given out by the gas engineer, why that is the consumer's own fault.

Mr. A. C. Humphreys—I would like to say a word on this topic, although I have not prepared myself for doing so. I was not fortunate enough either to hear the paper read, and had not read it carefully before coming into the room, as I was detained by other business. I would like, however, having glanced over the paper and got an idea of its general tenor, to raise a voice of protest against the apparent idea which runs through it, that the photometer cannot be relied upon for any really thorough work. I believe that the photometer, if intelligently used, and used as Mr. Harper is eminently qualified to use it, can give us eminent satisfaction. I do not, for instance, find these variations between candle power and enriching effect, as I find quoted in this paper. My attention was called to this by one of the other gentlemen who preceded me in the discussion. At the top of page 10 reference is made to the effect of enriching with water gas, and where the increase over the theoretical effect of the observed candle power was found to be over 45 per cent. I believe if you use a very high candle power water gas you can, as in the case of very rich oil gases, get an enriching effect which is superior to its observed effect on the photometer. I explain that simply by our inability so far to completely adjust our burners for testing on the same basis. That of course seems to argue right along Mr. Harper's line of reasoning; but in practice that is not a serious thing. For instance, if we take coal gas of 15 or 16-candle power and enrich it with water gas of very much higher candle power, and use the ordinary methods of testing, with the Argand burner for the low candle power gas, and with the flat flame burner for the water gas, my experience is that you very nearly confirm by after experiments the results we have looked for from calculations of the mixtures; and that there is not usually a great difference, if we are careful in the first place to use the right burners upon the different gases. Of course we know there is no such thing as absolute candle power, but we can approximate very closely to correct results in our observation; and I believe that the photometer to-day can be made to serve the purpose for which it is intended quite as accurately as the other instruments which are used in our business and in other businesses.

Mr. Egner—I only want to say that the doubt thrown upon the accuracy of the photometer is probably largely, if not entirely, due to certain differences in the candles used, which differences cause the candles not to burn exactly alike. The principle of the photometer is right, the trouble as to results being traceable to our lack of proper standards to compare the gases with in that instrument. I believe, as other speakers have said, that if the operators are sufficiently careful they will get almost identical results.

Mr. Forstall—As pertinent to what Mr. Egner has said, I think the trouble with the photometer to-day, as a measurer of candle power, is due not so much to the candle used as to the impatience of the operator in not waiting until the candle burns rightly; in being in too much of a hurry to take his tests, and not waiting to take them until the candles are in a proper condition.

Mr. Egner—Those who have read up on the subject and who have had experience in the use of the photometer say that a good deal of the difficulty is due to the lack of getting the wick just right; it is twisted a little too much sometimes.

Mr. A. C. Humphreys—I do not want to have it understood that I felt that the photometer could be made absolutely accurate along the lines which have been referred to, or which Mr. Harper has been referring to, simply by substituting an absolutely accurate light standard. Of course that would not touch the point spoken of by myself and referred to by Mr. Harper. Even if we had an absolutely correct standard it would not reach that point at all. It is a question of the treatment of the gas which is going to be compared with the standard. I believe with Mr. Forstall that the inaccuracy introduced by the candle is not such a serious factor of error after all; that even with moderate care in experienced hands that trouble can be reduced to a very low point; but there are very serious things about that to be considered. A study of your results has to be made with many other points in mind, and especially this point—viz., the treatment of the gas as to character of flame and the changes in treatment due to changes in character of the gas.

Mr. Egner—I have made a great many tests myself and found as much as four candles difference of candle power in candles burning 120 grains per hour. I think the candles used are the greastest factor of inaccuracy introduced in our tests.

Mr. Thompson—We seem to be threshing over old ground here. If candles are the only difficulty why not use the slit, and standardize the slit by the candle, measuring the height of the flame, instead of taking the consumption by weight? Dr. Kruse, Dr. Bunte and others have been quoted in Palaz's "Treatise on Industrial Photometry," and have stated very clearly the differences between the various forms and constituents of candles and their consequent rates of burning; and it is pretty well demonstrated that with paraffine candles a height of flame of 46 millimeters (or 1¾ inches) will give a consumption of 120 grains of sperm per hour, and will give a more uniform emission of light than the average candle burned at that rate by weight.

Mr. Harper—I would like to say in reply to the suggestion that the determinations of the paper are inconclusive, that I admit that, and for the reason which I have clearly stated I have tried to show how inconclusive it must necessarily be by the present day photometric methods; and I think I have succeeded so far at least. So far as burners are concerned, in the table that Mr. Miller will find on page 14 he will see certain tests which have been made with burners. Mr. Miller has made similar tests. He has a right to stand by those tests, and so has any other man. I have made quite a number of tests of the same kind, and I am inclined to stand by them. This table has no reference whatever to actual loss with high candle power water gas. In fact the question of water gas, so far as this country is concerned, has been previously disposed of in the paper where I say that over 71 per cent. of all the gas made and sold in this country is water gas. The table, and the other statements made, practically refer to coal gas only. So far as the photometer is concerned, I may say there seems to be a prevalent idea that I am attacking the photometer. I only say, as Mr. Humphreys and Dr. Moss have already said, that with reasonable care it can be made to give accurate readings. We all admit that. What I am trying to show is the difference in methods, and I think this "deadly parallel" shows there is a very distinct difference in methods. I refer especially to this statement by Mr. Hunt. Previous to reading it, however, I will say it is quite true, as Mr. Miller said, that these are not American authorities does not argue that the men are unknown. In the closing part of Mr. Hunt's remarks he says, "Indeed, it is as easy to show that an enricher possesses no enriching value at all as it is to show that it possesses many times its true value, if unsuitable burners be selected for testing either the unenriched or the enriched gas." That is the bone of my contention. We use no absolutely uniform method of testing, and that is all I try to contend for throughout the paper. I make no attack on the photometer as a scientific instrument. What I tried to aim at in this discussion—and I have secured what I had aimed at by the discussion—is the importance of getting down to some uniform method of using the photometer; for is it not reasonable to assume that, if one man uses a flat flame burner for a certain quality of gas, and another man uses the Argand burner

for a certain other quality of gas, that each will get different results. Mr. Miller, in referring to the heating value of uncarbureted water gas, made the statement that the flame temperature of uncarbureted water gas was very much higher than that of coal gas. That is admitted; but I do not think Mr. Miller will venture to say that the flame temperature of uncarbureted water gas is equal to that of decomposing acetylene, and that is just where the kernel of the question lies. I believe Mr. McDonald's question was answered by Mr. Doty; but I may say that the flame temperature is developed from the decomposing acetylene itself. Speaking from memory I think I may say that Prof. Lewes has demonstrated that even in a straight acetylene gas flame there is only about 14 per cent. of acetylene at the commencement of luminosity, and that the remaining percentage of acetylene has been used in getting up that flame temperature necessary for the decomposition of the remaining 14 per cent. In answer to Dr. Moss, as to the general tenor of the paper being inclined to establish the fact that water gas was used in this country for production alone, I may say that I have not made the statement that it is used for production alone, but I think those of us who are acquainted generally with the daily affairs of the gas companies of this country will admit that that as a rule has been the fundamental idea, rather than the question of enrichment. It was with such idea in my mind that I have frequently referred to water gas in the way that I have, because it is really a method of production and enrichment combined. I think in the way it is used in this country the results stated by me are justified.

Mr. A. C. Humphreys—The statement is made by Mr. Harper, at the bottom of page 12, that "No percentage of acetylene added to uncarbureted water gas will produce a luminous flame." Does Mr. Harper mean by that to say that if acetylene is mixed with water gas you cannot get any percentages or any proportion which will give a luminous flame?

Mr. Harper—That refers to uncarbureted water gas, or straight water gas pure and simple.

Mr. A. C. Humphreys—Would not 99 per cent. of acetylene and 1 per cent. of water gas produce a luminous flame?

Mr. Harper—It would be faintly so.

Mr. A. C. Humphreys—I think you will find that under 14 per cent. you commence to get your luminous flame.

Mr. Harper—With regard to these illuminating values, I forgot to mention to Mr. Miller that the statement made there is based on the statement of Prof. Lewes himself; and this entire table with regard to the admixture of acetylene and coal gas is quoted from the paper of Prof. Lewes. I am perfectly willing to leave Mr. Miller and Mr. Lewes to fight it out.

Dr. Moss—It occurs to me that, by the combustion of the acetylene and the uncarbureted water gas, composed as it is chiefly of carbonic oxide and free hydrogen, we get a direct conversion into carbonic acid and water, and so there must be a very high, intense thermal energy there, and as they combine very rapidly, possibly that may account for Mr. Harper's statement. That flame must be very thin on account of the hydrocarbon being present in very small amounts. I do not say that it is so, but it occurs to me that it may be so.

On motion of Mr. Jenkins a vote of thanks was given to Mr. Harper for his paper.

The President then introduced Mr. C. W. Blodget, of Brooklyn, N. Y., who read the following paper on

THE USE OF GAS FOR PURPOSES OTHER THAN LIGHTING.

From 1726 when Dr. Hales, who first obtained gas from coal, amused his friends by filling a bladder with it, puncturing a small hole therein and lighting the issuing gas, to the time of Murdock, who conceived and carried into successful operation the idea of the general manufacture and application of gas as a substitute for lamps and candles, down to the present, light has been regarded as the principal sphere of gas; and the primary object of every gas company, with a few notable exceptions, has been the manufacture and sale of gas for illumination Incidentally its use for other purposes has been welcomed and fostered to a degree, especially during the last quarter of a century; but the dominant thought has been light first, last, and all the time. Nor is this to be wondered at, since it is to that feature of the business our prosperity, in fact existence, has depended.

But because this has been and is the condition, should it necessarily continue so? Has not the time arrived when the use of gas for purposes other than lighting can be so extended by proper push and energy as to largely reduce or eliminate the disparity now existing between light, heat and power.

From a local standpoint, regarded through personal spectacles, an emphatic affirmative response can be made to the above, with the added statement that what is possible to attain in one locality can be compassed proportionately in other places. Our manufacturing friends have furnished us with gas cooking and heating stoves, gas engines and gas furnaces, the economy and utility of which, excepting heating, must be admitted, since they have demonstrated the fact. Each year the efficiency has been increased and the cost reduced, and to-day we have gas ranges which do 50 per cent. better work, at prices one-half the sum charged 10 years since, while gas engines are now sold at two-thirds the old cost, and do better work with a lessened consumption of 20 per cent.; in addition to which most of us have voluntarily, or under compulsion, reduced the selling price of gas, all of which should and does enable us to largely increase our output by the the sale of these appliances. Has the gas man ever done anything commensurate with the manufacturer to help his own business through the medium of heat and power? How many of us can answer, otherwise than in the negative, the very pertinent question which a prominent advertiser asks, to wit: "Have you ever actively given us any support in our efforts in your behalf?"

The reason for this state of things is undoubtedly owing to the very satisfactory increase in consumption which has come year after year to most gas companies, to obtain which only normal efforts have been necessary, and these along the old familiar lines. To deceive one's self is very easy of accomplishment, especially with figures, unless care is taken to analyze them, in illustration of which your attention is called to the following comparisons made between the years 1887 and 1897.

The total output shows an increase of 259 per cent. for the 10 years, the night consumption being 213 per cent. greater in 1897 than in 1887, while day sales ran up 621 per cent., and represented 22 per cent. of the entire business done. Whereas in 1887 the use of gas for purposes other than lighting was limited to 11 per cent. of the whole volume. The monthly percentage of day growth was:

January.....	418 per cent.	July.....1,119 per cent.	
February.....	354 "	August....	842 "
March.....	418 "	September.	682 "
April.....	643 "	October....	486 "
May.....	758 "	November.	397 "
June.	1,019 "	December..	377 "

Which shows very clearly that, while the heating stoves did excellent work, the results were small when contrasted with the cooking appliances.

Comparing the day consumption of 1897 with that of the night for 1887 by months, the following are derived:

Jan.....	49 per cent.	less.		July	147 per cent.	greater.	
Feb.....	52 "	"		Aug.....	88 "	"	
March.....	37 "	"		Sept.....	12 "	"	
April.....	6 "	"		Oct.....	35 "	"	
May.....	27 "	"	greater.	Nov..... ...	52 "	"	
June.....	113 "	"	"	Dec.....	52 "	"	

By which it appears that the day output of 1897 was 8.34 per cent. less than the volume of night business in 1887, and the total sales of 1887 were but 18 per cent. greater than the day consumption of 1897.

The above may appear fairly satisfactory work, and in one sense it is, but a probing down still further tends to take away much of the gratification that the figures produce at first glance; for, on examining the consumption per consumer, we find that the average in 1887 was 29,000 cubic feet, while in 1897 it is 20,000 cubic feet, a falling off of almost one third; and but for the increased quantity of gas used in stoves the decrease would have been close to 40 per cent.

Here is a condition that is anything but pleasant to contemplate; to think that the business has been developed only by increasing the expense of indexing, collecting, bookkeeping and stationery, to the extent of 50 per cent. over what it formerly cost for these items, to say nothing of the outlay made necessary for services, meters and connections. Will anyone, under these circumstances, deny that it is high time prompt and energetic measures were taken looking to a means of securing a use for gas other than lighting.

The mention of the foregoing is not alone for the reason stated, but to emphasize the fact that not only is it desirable and advisable to secure other uses for gas than lighting, but to show that such procedure is, in some instances a positive necessity; for the time will come to most of us, as has already been the case with some, when annual reductions in prices charged will have to be made, which will take from our profits 8 to 11 per cent.

The effectiveness of gas in cooking, its readiness in use, the ease and certainty of graduating the heat to the required temperature, reliability,

comfort, and, last though not least, its economy, are all so well known to you, that anything said here under those heads would be not only superfluous, but presumptuous.

What we need is to take steps to educate the consumer to the same extent in this direction and see to it that each one becomes in practice an exponent of the teachings. With us the users of gas cooking appliances consume monthly thereby an amount of gas equal to their average consumption for lighting; but up to now their operation is restricted to five months, and then, in almost all cases, two days' consumption per week is lost, owing to the coal range being lighted for laundry work and washing.

This 40 per cent. increase should be secured, and can be, by means of the devices put on the market recently for heating the boiler. But to insure success from the standpoint of economy, see to it that every attachment of this kind is furnished with a thermostat. With such installation, the working days of the gas range can be made to cover the seven days in the week, and the term of service will be extended from one to two months. As a matter of fact, it ought to continue throughout the entire year, and their use for that period may be maintained by leading a flue from the heating furnace to the kitchen, and so keeping the latter warm during cold weather.

Conservative figures, based on the above, indicate clearly that the use of gas for cooking purposes should give us as a minimum an output equal in volume to 50 per cent. of the total business now done, without taking into account the gas which would be used for heating the boiler.

The field afforded for the use of gas by means of the gas engine is seemingly neither understood nor appreciated, judging from the way it has been neglected and ignored by most gas men, in spite of the fact that it gives us the opportunity of extending and increasing our business enormously and along lines that will perpetuate it beyond question.

Inquire into the cost of power begotten for steam for almost any purpose and you will find it difficult to discover a user who, by discarding his boiler and steam engine, and substituting therefor a gas engine, will not save from 10 to 50 per cent. This has been demonstrated time and again. The proportion of those employing steam power, from, say, 100 horse power down, in our section is by rough calculation one to every 34 consumers; but we will cut the figure in half and call it 1 to 68. These 68 consumers would represent an annual consumption of 1,360,000 cubic feet. The average size of gas engines sold locally is 15-horse power, consuming, say, 20 cubic feet per horse power per hour. We will assume, however, that full load would be carried only two-thirds of the time, and, disregarding the gas used during the other third, the consumption would be 200 cubic feet per hour, 2,000 cubic feet per day of 10 hours; and with 300 working days per annum, the engine uses 600,000 cubic feet, equal to the agregate consumption of 30 average customers.

Any comment on the above would be redundant, and an estimate of the number of gas engines that could be sold to displace the steam engines, supported only by theoretical assumption, might subject the calculator to the charge of being an enthusiastic dreamer. Don't lose sight of the fact, however, that there are many trades and industries that could use a gas engine with advantage, that are now dependent on hand power, and their use of gas would by no means be an insignificant total.

In every instance where a gas engine has displaced an electric motor the expense has been cut in two. This statement is not a figurative one, being made after comparing respectively the bills of the electric company and gas company as rendered to the customer for equal time and doing the same amount of work. Some time since figures were made (for the sake of amusement, aparently, since nothing has ever been done) going to show that small stations for the supply of electricity for incandescent lights, the current being derived from a dynamo driven by a gas engine, could be established throughout the city, and the lights furnished for, at most, one-half the sum being charged. The computation was based on retail rates for gas, full allowances for initial cost of machinery and apurtenances, rent, supervision and 10 per cent. for depreciation.

The proposition was undoubtedly regarded as a chimerical project. Well, possibly it was; nevertheless, such plants are now running in places not far removed from Brooklyn, and daily demonstrating the correctness of the estimates given. The range of possibilities for extending the use of gas in this direction is certainly not small, and should be followed up; especially by those who are favored with the competition of electric light companies.

In this connection your attention is directed to the operation of a corporation which is endeavoring to have adopted a special system for propelling street cars with storage batteries, charged with electricity generated by a gas engine driven dynamo. Detailed information relative to cost, etc., is at present impossible of attainment, still it is safe to assume that their action is not prompted by any philanthropic consideration of the gas company.

Regarding the gas furnace, there is one type on the market which is about as nearly faultless as will in all probability ever be devised, for the combustion of gas, is practically perfect, and the sensible heat from the resultant is utilized to the extreme limit; and although its use involves a greater expenditure, direct, than does the coal furnace, the first performs properly and satisfactorily the duty designed for it. This is seldom, if ever, accomplished by the latter, which as a rule keeps the temperature of a house around 80° in moderate weather, and when the mercury gets well settled down toward the bulb promptly follows suit and drops to somewhere between 50° and 60°, particularly in the morning, when one's circulation is poorest and the system least fitted to withstand shock or exposure.

With a gas furnace controlled by a thermostat, any desired heat may be obtained and maintained every hour of the day and night throughout the entire winter.

Is neither health, comfort, cleanliness nor safety worth anything? Can you not afford to pay something for an appliance that only requires the striking of a match, the turning of a button, and it does the rest; that necessitates no trips to the cellar, no coal or ashes to be handled, no shaking of grate bars, no coal dust or fine ash silted throughout the house, injuring everything they touch; no discomfort or sickness caused by noxious coal furnace gases or improperly heated rooms, and no danger of fire from overheated flues? Do not the benefits secured fully and completely offset the increased cost of running the gas furnace?

There is one serious impediment to the successful development of the use of gas for purposes other than lighting which exists by reason of our own actions, in that too many of us preach what is not practiced.

How many gas companies use their product for power purposes? What proportion of the executive officers, directors or stockholders have their meals cooked, laundry irons, boilers or houses heated by means of gas? It is another case of "do as I say, not as I do," and it doesn't pay. On the contrary, such course militates against the interests we are supposed to conserve and should be amended promptly.

When this is achieved, then properly applied energy will expand our business to such an extent that the amount now done will seem insignificant by contrast.

Discussion.

The President—You have before you for discussion this very interesting paper by Mr. Blodget. I believe Mr. Cowdery has some facts and figures of interest in this connection.

Mr. E. G. Cowdery—I agree generally with Mr. Blodget in his theories and conclusions. The only thing that I could add to Mr. Blodget's paper would be perhaps to give you the statistics in another locality as compared with his, and which will probably only go to confirm Mr. Blodget's conclusions; and I may perhaps be able to give you a statement of some uses to which we found in practice gas may be put for other than illuminating purposes, more or less successfully. Mr. Blodget compares the day and night consumption, and by such expression means I presume from 6 A.M. to 6 P.M. as the day consumption, and the balance of the 24 hours as night consumption. Such hours apply to day and night consumption, as I will refer to them. It has been impossible for me to compare the figures with those of Mr. Blodget, preceding the year 1890, except in a very indirect manner. The following increases are noted however: The output increase of 1897 over 1887 was 150 per cent. as against Mr. Blodget's 259 per cent. The output increase of 1897 over 1890 was 100 per cent. The day output increase of 1897 over 1890 was 207 per cent. Mr. Blodget gives it for the 10 years, for 1897 over 1887, as 621 per cent. The night output increase for 1897 over 1890 was 50 per cent. Mr. Blodget gives it for the 10 years as 213 per cent. The day per cent. of total output increase for 1897 was 47.5 per cent. Mr. Blodget gives it as 22 per cent. The day per cent. of total output increase for 1890 was 30 per cent. Mr. Blodget gives it for the year 1887 as 11 per cent. The summer day per cent. for 1897 over 1890 was 550 per cent. increase. Mr. Blodget gives it for the 10 years as 1,119 per cent. The winter day per cent. of increase, for 1897 over 1890, was 125 per cent. Mr. Blodget gives it at 337 per cent. This you will notice was against a summer day per cent. of 550. The summer night per cent. of increase, in 1897 over 1890, was 50 per cent., while the winter night increase for the same time was 41 per cent. The day output for 1897 equaled the

total output of 1890 with us. Mr. Blodget gives the day output of 1897 as 85 per cent. of the total of 1887. The day output of 1897, in excess of the night output of 1890, was 36 per cent. The day output of 1897, less than the night output of 1887, with Mr. Blodget, is 8.3 per cent. It should be noted that, with us at least, the statistics show the day send-out during these years has increased regularly, and in proportion with the fuel gas sales. The sale per meter for 1887 was 31,450; Mr. Blodget gives it as 29,000. The sale per consumer for 1897 was 38,000 per meter; while Mr. Blodget gives it as 20,000. Thinking possibly that Mr. Blodget may have made it from the meter instead of from the consumer, I will state that the sales per meter for 1897 were 23,100; that the sales per illuminating meter for the same time were 22,000; while the sales per fuel meter for the same time were 24,000. Fifteen years ago and upwards, we were not considering ways to increase our daily output in order to equalize such output throughout the 24 hours; yet with us that has been the result. For the year 1897 the percentage of day output to the total output of each month of the year was as follows: January, 45.6; February, 42.3; March, 41.2; April, 44; May, 48.4; June, 53; July, 55.7; August, 52; September, 49; October, 45.9; November, 47.4; December, 48.4. With us the problem of keeping the gas range in use seven days in the week, and throughout the year, has not arisen. Among the class of people using gas the tendency is to make the range permanent and its use for cooking exclusive. At present 70 per cent. of the ranges in use are used exclusively and throughout the year. Mr. Blodget says that 50 per cent. of the gas sold should be used for cooking; that is, should equal that sold for illuminating and all other fuel purposes. I am not quite so sure of that, but I am admitting that the use for fuel should equal the uses for illuminating purposes. With us, for the year 1897, the sales for fuel were 38 per cent. of the total, or 41 per cent. of the total, with street illumination left out of consideration. The sales for fuel with another company with which I am connected were last year 47 per cent. of the total, and the fuel end of the business still growing rapidly. Mr. Blodget presents some figures upon the amount of gas used by gas engines, and in this connection I believe that some reliable data will be interesting. At the close of 1897 we had 96 gas engines in use, 26 of them introduced during the year, the latter averaging two months' use. As these were introduced at various periods throughout the year it was equivalent to 72 engines in use for the entire year. So that the figuring would stand for the 96 engines in use throughout the entire year, for at the close of the year there were 96 in use. The total consumption averaged 18,300 cubic feet per horse power per annum, taking the number of engines in use at the close of the year; but taking the 72 engines which were in use throughout the whole year the consumption would average 24,300 cubic feet per horse power per annum, the engines averaging 9-horse power in size. For four months of this year we have put in 16 engines, averaging 11.4-horse power each. We find the gas engines in use in machine shops, shoe factories, tanneries, carpet cleaning works, spice mills, bakeries, grain elevators, telephone stations; also in use for grinding coffee, for electric machinery, swing bridges, ice cream freezers, meat choppers, and for running printing machinery, sewing machines, ventilating and heating apparatus. Quite a number of large engines are in use for the latter purpose. The uses to which gas for fuel purposes may successfully be applied are: For heating enameling and japan ovens; for heating laundry and tailor irons; for brazing; for lineotype machines; for heating tools in shoe shops; for soldering purposes; roasting coffee; heating forms and blocks in hat factories; for ripening bananas; for heating irons; for polishing leather in tanneries; for heating metal plates for sign manufacturers; for candy makers; for heating branding irons; for laboratories; for firing china; for boiling meats; for heating glue. There may be extensive uses found also for fuel gas for heating purposes in brass foundries; in machine shops; for babbit metal works, and for blacksmith's forges for tool and forge work. In many of these uses the consumption in our city has grown to what may seem to some quite astonishing figures. In 1897 the amount used for laundry and tailor irons was 8½ million feet; for enameling 3½ million feet; for soldering furnaces, 1¼ million feet; for heating tools in shops, 2½ million feet; for roasting coffee (by one consumer alone), 1¼ million feet; for brazing purposes, 2 million feet; for heating forms in hat factories, 1½ million feet; for lineotype machines, 2¼ million feet. We have lately done what I think all of us should do, put a man out under salary among the manufacturing plants of the city to devote his entire time and attention to finding out new uses for gas for fuel purposes. There appears to have been a general interest created in the question as to whether manufactured gas would come into use for general heating purposes, and it may not be wholly out of place at this time to consider its use for such purpose. We have made several experiments in that direction in the past few years. Some were made with the copper reflector stoves, some with the Backus heaters, and once with an indirect hot water system. Without going into details, each case gave a value of 30 cents per 1,000 cubic feet as compared with anthracite coal at $6 per ton. Each case giving practically the same results, some confidence in the figures was established. The past winter we determined to make a more extensive experiment. A special boiler, constructed for the use of gas as fuel, was attached to a direct hot water system in an eight-room house, with a capacity to be heated of 30,000 cubic feet. From October 15 to May 15, seven months, which is considered the heating season in Milwaukee, 370,000 cubic feet of gas was used. Stated differently, 2.12 feet per hour of gas was used for each degree of difference between inside and outside temperatures, or .71 of 1 cubic foot of gas per hour was used for each degree of difference between outside and inside temperature, for each 10,000 cubic feet of space heated. This experiment was tried in an isolated frame house of modern construction, exposed on all sides, in the most severe locality in our city. It should be stated that the boiler was far from being the best constructed for the purpose, and that the burner did not admit of enough variation between the maximum and minimum consumption. This house ordinarily requires for heating 15 tons of anthracite coal, which, at $6 per ton, equalled $90, which is equivalent to 25 cents per 1,000 for gas. It is believed that without doubt a better boiler and better adapted burner would give 20 per cent. better results, which would be equivalent to 30 cents per 1,000 cubic feet for gas. The care of coal heating apparatus for seven months, at $6 per month added to the cost of the coal, would give an equivalent value to the gas of 40 cents per 1,000 cubic feet. In addition I would say that the rules laid down of .71 of 1 cubic foot of gas per hour for each degree of difference between the inside and outside temperature is believed to be, for this character of house, a very fair rule, as it was shown throughout the entire season to remain at just about the one figure for each month. The .71 is the equivalent of 2.12 feet for the 30,000 feet of space heated. The lowest month in that time was 1.83 feet, which was maintained in the months of April, May and October. The highest month was 2.21 for December and 2.19 for January. It varied regularly between those figures from October to December, and from January to May.

Mr. Forstall—In relation to the subject of house heating by gas I will say that I made an experiment which continued about two years. I put in a hot air furnace, heated by gas, in place of a hot air furnace heated by coal, right in my own house, and I find that my figures are practically the same as those given by Mr. Cowdery. Where 8 gross tons of coal per year had been used to heat the house, I used 176,000 cubic feet of gas, and I think (although I have no exact figures on that point) that the house was better heated by the gas than it was by the coal. As Mr. Blodget says, our cold weather temperature there was the same as the warm weather temperature, and that is not always true with the use of a coal furnace. The figures would work out at just about 20,000 cubic feet of gas per ton of coal. But the question there comes in as to whether that is a business we really wish to encourage. I am not prepared to say that it is or is not. I found during that experiment, in the course of which I took the consumption of gas every day, and the outside temperature every day, and recorded it, that the consumption of gas would jump 1,000 feet on consecutive days. One day the heater would burn 1,000 feet of gas and the next day it would burn 2,000—depending upon change in the weather—and not only as to changes in temperature but as to the amount of sunshine, which of course makes quite a difference in heating a house. If you have a nice, sunshiny day, even if it is cold, it takes less heat to keep the house warm than it does on a moderately cold day which is cloudy, rainy and chilly. Now that extra consumption coming in just at the time when all the other extra consumption comes in, seems to me is going to do away with all the advantages that we have been trying to gain in getting our load line leveled down by increasing our load factor. It is a question in my mind whether we can afford to make any great reduction from our ordinary price to sell this gas for heating purposes, when we take into account the extra investment, either in generating apparatus or in storage capacity, whichever way you choose to put it, which will be necessary to meet these sudden changes. Suppose that you have 1,000 of these furnaces in your town, and each one of them jumps in consumption 1,000 cubic feet of gas on a given day, you have to look out for 1,000,000 cubic feet of gas as between one day and another. You have to be provided for it; and the question must be considered pretty closely whether that extra investment could be paid out of the profit arising from the extra sales of gas used in that way for heating purposes.

Mr. Cowdery—I do not think it is desirable to work up a use of gas for general heating purposes on account of the extremely great amount that will be required in very cold weather. It seems to me that what we want is a combination furnace, with which we would be able to use coal in the extremely cold weather and use gas in the milder weather of the fall and spring. It is necessary, however, for us first to find out what we are able to do with the gas, whether we can attempt to use it either in the mild weather of the fall and spring or in very cold weather.

Mr. A. S. Miller—Mr. Blodget gives some figures in his paper comparing the cost of gas for engines with the cost of electricity. I would like to know if he would be willing to state what the cost of electricity is per kilowatt?

Mr. Blodget—I cannot answer it in that way.

Mr. Miller—Do they give a flat rate per horse power?

Mr. Blodget—I based my statement upon the nominal charge of 2 cents per horse power per hour, and of course on that basis it would be just about the same as gas; but, unfortunately, when the manufacturer gets his bill he does not figure it out in that way.

Mr. Egner—Mr. Blodget has given us an excellent paper on the use of gas for purposes other than lighting, and he has been followed by Mr. Cowdery, giving us many valuable statistics; but I am disappointed in seeing that one subject—which I will mention to members that they may take it home with them and think over it—has not been referred to. Among the purposes for which gas may be used to advantage, and is now so used very largely on the other side, in England and Germany, is its use in the gas motor engine for drawing cars. I will give you a few figures with relation thereto. The ordinary street gas is used, compressed to about 8 atmospheres, or about 120 pounds per square inch. It takes 1½ minutes to fill the car reservoirs at the end of the round trip. The speed allowed by the Board of Trade is 8 miles per hour, but there is no difficulty in running the cars at 15 miles or more per hour. The cars can climb a grade of 1 in 26, and can round ordinary curves in city streets with ease. A compressor run with an 8-horse power gas engine can keep two cars going continually. Cars seating 25 persons require on an average 29.8 cubic feet of gas per mile, which also includes the gas used by the compressors. In other words, this is the average gas used per mile run per car running, including all gas used by the railway. In very bad weather, in snow and storm, cars have used 38 feet per car mile, but the former is the average for the year. A car with motor complete (10-horse power), seating 25 persons, did cost $3,346; open "trailers" cost $375; closed "trailers" cost $700; the salt car cost $250; the snow plows $200; the repair car $100. The buildings, including wagon depot, stock, compressing house, salt and tool shed and office building, cost $11,643. The road bed cost $8,603 per mile. This is for a road in a city with well paved streets for the most of the way. The mileage of tracks is 5½, including all. The company quoted from has nine 7 to 9 horse power cars; four 10 to 12-horse power cars; two open and two closed cars; a snow plow, salt car and repair car. The above is from the annual report of a successful gas motor operated street railway in Germany. On a certain trial trip a gas motor car, with saloon "trailer" car attached, made a round trip of 17 miles, carrying 18 persons, at an average speed of 13½ miles per hour. The gas used was 347.7 cubic feet for the round trip. The superintendent of a gas motor street railway gave me the details of operation of his line and it is seen that a certain car ran 5,625 miles using 25.5 cubic feet per mile run. The engine was a 10-horse power. The motor car subject to trial test weighed 17,820 pounds, and reached a speed of 15 miles per hour. It carried enough water and gas to enable it to make a 25 mile run. The most favored method with gas motor experts is to build the motor part independent, and with it hauling the passenger cars as trailers. Fine cars are now built and running, with motor on cars, each car carrying 40 persons, seated; but the trailer car is more favored by the builders. The gas motor car is recommended for ease to get at for inspection and repairs to machinery. There is also a saving in running expenses. If used for switching purposes as a regular locomotive, only one man is required in attendance on the engine. It does away with smoke and dangerous sparks, which are objectionable where trains must be hauled in city streets, through tunnels or through fields. In the cases of two well known roads, one operated by electricity and the other by gas motor cars, the expenses of the gas road are less than one-half those of the electric operated road, for the same items of operation. I think that the figures I have given are worthy your consideration. I am not interested in the matter one way or another. I saw the road in operation over there, got these data and brought them home with me. If any of you want any further information I shall be glad to give it to you.

Mr. Lynn—Regarding those gas engines in the vicinity of Brooklyn which are used to drive dynamos, I would like to ask Mr. Blodget the size of those engines.

Mr. Blodget—Those that I have knowledge of are from 50 to 20 horse power.

Mr. Lynn—Do they experience any difficulty with a 50 horse power gas engine?

Mr. Blodget—I have not heard of any.

Mr. Lynn—I asked that question because I know of one 50-horse power gas engine used for a like purpose that in starting it off it was almost necessary to get half the town there to assist.

Mr. Blodget—I have heard of such cases.

Mr. T. D. Miller—I have known of a use for the gas meter which no one else has mentioned, and that is to keep hot tamales, which is quite an item in some southern places. It is quite a gratification to me, after having travelled 1,800 miles, to find that the average sale per meter in some of the large northern cities is not quite equal to what it is in our village of Dallas, Texas, in the south, where our sales for gas for 1892 overaged 33,000 feet per meter; for 1897 they were 22,000 feet per meter. The number of meters had increased of course. I do not regard the day sendout as a fair showing of what you are doing in the fuel business. Our day sendout in the aggregate is over 40 per cent. of the total. There have been days, of course, in which that would vary very much. If the day happens to be unusually cloudy, or is a very dark, cloudy and rainy day, the sendout for the day will often be much greater than the sendout for the night. In order to anticipate possibly the objections of consumers at the end of the month, as to the size of their bills, we have for the past six years kept an exact record of the maximum and minimum temperature of the atmosphere, and of the conditions of the weather, for every hour in the 24. That is recorded and reported to the office at the end of each month. The cashier at the window has the record before him, and if a complaint comes in, as there did last December, which was an unusually bad month, in fact, the worst December in six years, and the consumers were all kicking about the size of their bills, one consumer made a strong kick to the cashier, and the latter said: "Well, December was an unusually bad month this year, the worst we have had for many years." The consumer replied, "No, it was not." The cashier said: "I know what I am talking about, here is the record. This is the correct record for every hour in the 24. Now if your memory is any better than this record made at that time, I will admit you have the best of the argument; if not, you must yield." Now, with regard to the use of the gas engine, I may say that possibly our conditions are very peculiar, but at one time we had quite a large number of engines in the town; they were of the old slide-valve kind, and many of them did not have the changeable or duplicate seats and valve. These engines were the cause of quite a great deal of trouble. When I got there I found two or three old engines stored in a warehouse, which had been taken in because the owners failed, and the consumer turned over the engine for what it was worth. We have never offered a flat rate as the electric light companies give on their motors. Those who buy new gas engines are very much pleased with the service. In one case a party wanted a new engine, and we offered to take back the old engine in part payment, but the electric people came in and offered an electric motor at about the same net cost as a new gas engine, but made a flat rate for the motor, and the purchaser told me in confidence that the reason he took the electric motor was because he would not have to pay anything for the extra hours that he ran, and that half the time he used it until midnight.

Mr. Cowdery—I think it should not be overlooked that there is a new competitor in the field with the gas engine (probably not new altogether, but new in one sense, and to which we will have to pay more attention) and that is the gasoline engine. Even with the very low price for gas in our city, we find some competition from the gasoline engine. It is said, and I believe truly, that the gasoline engine can be run at the equivalent of 50 cents per 1,000 feet for gas. Of course we all understand that there is a little more risk with the gasoline engine, and in some cases more insurance is required where the gasoline engine is used; but perhaps there are not many who will not pay something additional for the sake of getting rid of this risk.

On motion of Mr. Doty, the thanks of the Association were voted to Mr. Blodget for his paper.

[To be Continued.]

AT a meeting of the shareholders of the Port Huron (Mich.) Gas Company the officers chosen were: Directors, E. T. Lynch, Jerome Croul, J. T. Lynn, A. D. Bennett, I. C. Baxter, W. L. Jenks and James Goulden.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

MR. G. B. GUNDERSON, Secretary and Treasurer of the Detroit (Mich.) Stove Works, writing under date of May 26th, says: "We inclose herewith an exact copy of a letter which we have just received, and, as it is such an interesting one, we thought it might possibly be worth publishing. It hardly can be considered advertising, as the writer does not use our make of stove, having purchased her stove before we made gas ranges."

AGREEING completely with Mr. Gunderson's presentation of the spirit of Mrs. Daskam's testimonial to the merits of the gas range, we will take the chance whether or not our readers consider the same advertising.

"STAMFORD, CONN., May 23d, 1898.

"Detroit Stove Works, Detroit, Mich.: Dear Sirs—Thanking you for both books, concerning 'Cooking by Gas' and the 'Gas Range Catalogue,' I must tell you that I have had a gas range for five years, and each year it has increased in value. At times I am tempted to take a trip through the country, hire a hall in each town I pass through, and convince every woman within reach of my voice that, about gas ranges, 'The half has never been told.' Like every housekeeper of 25 years' experience I had times when I longed for a 'Lodge in some vast wilderness' where cooking and dirt play a prominent part; but when I remember that, as far as heard from, the wilderness is not piped for gas, I look at my gas range and regret that, for a moment even, I forgot its value as the one device in my kitchen that is always the same—no waiting for the fire to burn, no dirt, no trouble; nothing other than complete success. The English language fails me, and my knowledge of foreign tongues is insufficient to help me out, but please understand that one woman is heartily grateful to you for the part you play in making cooking a pleasure. If every woman could claim as her birthright a gas range, the milennium would be close at hand, if not already here. I could write a book on the uses, comfort and cheapness of gas ranges, but you do not need that information. Please think of me as a grateful well-wisher.—Yours truly, MRS. H. DASKAM."

A SECOND reading of Mrs. Daskam's letter conveys the idea that, if she is not in the advertising business, she might engage herself in other lines less profitable.

DESPATCHES to the New York press, dated the 30th May, from Greenwich, Conn., are to this effect: "Frank S. Hastings, Private Secretary to E. C. Benedict, was seriously injured, in his mansion at Indian Harbor, yesterday morning at 6 o'clock. He opened his wine cellar, having arisen early to unpack some boxes of bottles. Acetylene is used in his house, and when the generator was turned off last fall probably the apparatus was defective to the point of permitting an escape of gas into the wine cellar, which is 10 feet square. When Mr. Hastings (holding a lighted match) entered the apartment an explosion followed. He was thrown about 20 feet, his clothes were badly burned and his hair was singed. The force with which he was thrown against the closet door caused the breaking of the latter, and rendered Mr. Hastings unconscious. The explosion raised the registers from the floor and blew out part of one side of the building. It is feared that the injured man will be a long time ill."

WE presume that the "injured man" is the Secretary of Mr. E. C. Benedict, and from his employer's connection with many commercial gas enterprises, we further believe that he should have known more about the dangers of gas from calcic carbide than he really did. However, we hope that he will be able to outlive his sores and his singes; just as Mr. Benedict seems to have done.

AT the annual meeting of the Consumers Gas Company, of Reading, Pa., the following Directors were elected: Henry Baumgardner, Samuel T. Bodine, Wayne MacVeagh, Edward C. Lee and R. L. Jones.

THE bill proposed in the Legislature of Massachusetts to permit the electric light companies of that State to engage in the manufacture, distribution and sale of gas, has been rejected.

MR. W. HARVIE WADE, writing to the JOURNAL under date of the 26th ult., says:

To the Editors AMERICAN GAS LIGHT JOURNAL: I wish to call attention to a new method of operating water gas apparatus not fitted with down run attachment. As far as I know this method originated with me last October in Johnstown, Pa. I have since brought it to the attention of the Western Gas Construction Company, of Fort Wayne, Ind., which Company has introduced it in several places. The method consists in blowing down through the fire at intervals, so as to keep the lower portion of fuel hot. After a run, when the fuel on the grate has been cooled below the temperature of ignition, open a door in the bottom of generator (cleaning, or ashpit door), close stack valve and open either carbureter or superheater blast valve. Care should be taken not to open this valve wide enough to blow air through the seal. The air thus admitted passes down through the fire, becomes heated and converted into producer gas, which gas heats the fuel in the lower part of the generator, and passes out through the open door before mentioned, to either burn or diffuse, according to its temperature. When the fuel on grate is sufficiently hot to burn with cold air the blast is shut off, the stack valve opened, the door closed and the apparatus blasted as usual. This up blasting should be continued until the fuel becomes hot enough for the proper decomposition of steam. With sets operated from the top floor instead of opening the bottom door it is convenient to have a pipe fitted with a valve connecting the generator bottom with the outside of building, the boiler furnace, or other suitable place. When the back pressure in the apparatus is small it is desirable to have a valve or other attachment to prevent air from blowing through the seal. With apparatus fitted with down run attachment more producer gas will be available for combustion in superheating chambers than in apparatus operated in this manner, but there is usually an excess of producer gas which has to be blown out of the stack valve. With a 6-foot apparatus in Johnstown, when the blast pressure was about 13 inches of water, we blew back three minutes every third run, and had no difficulty in fixing a 35 candle gas. Before closing I will call attention to a mistake frequently made by constructors of gas apparatus; that is, in keeping explosion doors to their seats by weights instead of by springs. The seats of these doors are in some cases nearly, or quite, vertical, which aggregates the evil. The mean pressure necessary to open a door, of 50 square inches area and 100 pounds weight, one inch in the fiftieth of a second, neglecting friction, sticking to seat, etc., will be about 25 pounds per square inch—enough to split an ordinary blast pipe.

AT the annual meeting of the Peoria (Ills.) Gas Light and Coke Company, the officers chosen were: Directors, Thomas Coffey, E. C. Moore, M. Farrelly, Nicholas Henebery, Leslie Robinson, M. Henebery and Wm. A. Herron; President, Thomas Coffey; Secretary, M. Farrelly; Treasurer, M. Henebery. The Company decided to carry out an extensive scheme of plant improvement, the same to include a new retort house and a water gas installation equal to bringing the daily output of the latter system up to 1,000,000 cubic feet. Much main laying will also be done.

RECENT advices from Philadelphia are to the effect that a new bill to enjoin the Apollo Incandescent Gas Light Company, of New York, from making and selling incandescent burners and mantles, has been filed by the Welsbach Light Company. The Apollo Company endeavored through the public prints to make it appear that it had gained a victory over the Welsbach Company by the dismissal of the motion. Counsel for the Welsbach Company was not ready to argue the case on the date to which it was adjourned, and as counsel for the other side did not allow the adjournment asked for, the bill was dismissed. Another was filed immediately.

THE proprietors of the Johnstown and Gloversville (N. Y.) Gas Company have determined to build a complete new plant on the site owned by them on Hill street, Gloversville. The plant, which is to be of the water gas type, will require the expenditure of perhaps $100,000.

WE are in receipt of a copy of the Bristol Company's new partial list of Bristol's recording instruments for pressure, temperature and electricity. Although the "list" is said to be only a partial one, it nevertheless catalogues 117 varieties and ranges. The Company informs us it will be pleased to forward the list to any inquirer. The address is "The Bristol Company, Waterbury, Conn."

THE Municipal Gas Company, of Albany, N. Y., according to a correspondent, has successfully completed a series of lectures on cooking by gas, the demonstrator having been Miss Emily M. Colling. The "lectures" were given in the Company's handsome offices, State and Chapel streets, and the attendance was up to the number which gave the lecturess courage and the Company satisfaction.

(*Continued on page* 903.)

THE AMERICAN GAS LIGHT JOURNAL

A. M. CALLENDER & CO.,

PROPRIETORS.

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ELBERT P. CALLENDER,

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CHAS. E. SANDERSON,

MANAGER.

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England—Aug. Siegle, 30 Lime Street, London.

MONDAY, JUNE 6, 1898.

(*Continued from page* 902.)

AN attempt to revive the Citizens Gas Light Company, which has for some years been more or less of a mythical concern in Toledo, O., is underway. The President of the phantom corporation is I. T. Merrill, and its Secretary is Thomas A. Taylor.

THE executive organization of the Mount Clemens (Mich.) Gas Light Company has been thus perfected: Directors, S. T. Douglas, Wm. G. Smith, George H. Payne and H. W. Douglas; President, S. T. Douglas; Vice-President, George H. Payne; Secretary, William G. Smith; Treasurer and General Manager, Henry W. Douglas; Superintendent, F. H. Hess. The Company is capitalized in $50,000, and the works will be constructed this season.

AT the annual meeting of the Hagerstown (Md.) Gas Company a semi-annual dividend of 3½ per cent. was declared. The executive management named was: President, Henry Steck; Vice President, E. W. Mealey; Secretary and Treasurer, Albert Heard; Superintendent, E. B. Spielman.

THE Davis & Farnum Manufacturing Company, of Waltham, Mass., is constructing a new holder for the Kennebec Light and Heat Company, at Augusta, Me.

THE proprietors of the Worcester (Mass.) Gas Light Company have reduced the net selling rate to $1.10 per 1,000 cubic feet. The gross is $1.25 per 1,000, and the concession for prompt payment, it will be noted is considerable. President Lamson and his associates are to be congratulated on the fidelity with which they have adhered to their promise of years ago to permit their patrons to share practically in their prosperity.

THE Redding (Cal.) gas plant has been acquired by the Redding Electric Light and Power Company.

THE Bellingham Bay Gas Company, of Fairhaven, Wash., is making notable additions to its main system.

The Market for Gas Securities.

There was no change of moment in connection with the week's trading in city gas shares, values in which held up well. Consolidated opened to-day (Friday) at 189½ to 191, ex dividend of 2 per cent., payable the 15th inst. New Amsterdam common sold off a trifle, but on the other hand the same Company's bond issue was higher. Brooklyn Union is 117⅞ bid, ex dividend; Peoples, of Chicago, is at 101⅝ bid, and the shorts in this instance have been taught a very salutary lesson. Baltimore Consolidated is 59¼ to 60, and Laclede common moved up sharply to 51¼ bid. Bay State is active, at a slight increase. We quote Milwaukee firsts at 100½ to 102.

Gas Stocks.

Quotations by Frederic B. Cochran & Co., Brokers and Dealers in Gas Stocks,

20 AND 22 BROAD STREET, NEW YORK CITY.

JUNE 6.

☞ All communications will receive particular attention
☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$36,230,000	100	189½	191
Central	500,000	50		..
" Scrip	230,000	..	100	.
Cental Union, Bonds, 5's	3,000,000	1,000	99½	100
Equitable	4,000,000	100	200	215
Bonds, 6's	1,000,000	1,000	105	..
" 1st Con. 5's	2,300,000	1,000	114	.
Metropolitan Bonds	658,000	..	108	112
Mutual	,500,000	100	330	335
" Bonds	1,500,000	1,000	100	102
Municipal Bonds	750,000	.	..	.
New Amsterdam Gas Co.	13,000,000	100	29½	30¼
Preferred	10,000,000	100	69½	70½
Bonds, 5's	11,000,000	1,000	99	99¾
Northern	150,000	50	..	
" Bonds	150,000	1,000	..	
Northern Union, Bonds, 5's	1,250,000	1,000	94½	95½
New York and East River	5,000,000	100	81	83
Preferred	2,000,000	100	112	115
Bonds 1st 5's	3,500,000	1,000	110	112
" 1st Con. 5's	1,500,000	.	105	107
Richmond Co., S. I.	348,650	50	70	..
" Bonds	100,000	1,000	..	..
Standard	5,000,000	100	140	142
Preferred	5,000,000	100	158	160
Bonds, 1st Mortgage, 5's	1,500,000	1,000	112	114
Yonkers	299,65	500	130	.
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	117¾	118
" " Bonds (5's)	15 000,000	1,000	114¼	115
Bay State	50,000,000	50	3⅝	3½
" Income Bonds	2,000,000	1,000	..	75
Boston United Gas Co.—				
1s Series S. F. Trust	7,000,000	1,000	..	92
2d " " "	3,000,000	1,000	70	..
Buffalo City Gas Co.	7,000,000	100	26½	27
" " Bonds, 5's	7,000,000	1,000	93½	94½
Central, San Francisco	2,000,000	..	95	..
Chicago Gas Co. Guaranteed Gold Bonds	7,650,000	1,000	104	104¼
Columbus	1,060,000	.	89	91
1st Mortgage	1,085,000	..	101	103½
Consumers, Jersey City	2,000,000	100	75	80
" Bonds	600,000	1,000	100	103¾
Cincinnati G. & C. Co.	8,500,000	100	204¼	205
Consumers, Toronto	1,600,000	50	184½	187
Capital, Sacramento	500,000	50	..	35
Bonds (5's)	150,000	1,000	..	..
Consolidated, Baltimore	11,000,000	100	59¾	60
Mortgage, 6's	3,600,000	..	107	107½
Chesapeake, 1st 6's	1,000,000	..	..	..
Equitable, 1st 6's	910,000	..	..	..
Consolidated, 1st 5's	1,490 000	..	..	..
Consolidated G. & E. Co.'s, Little Falls, N.Y.	90,000	100	..	100
Bonds	75,000	..	..	100
Detroit	4,000,000	.	58	58½
" Con. Bonds	4,812,000	..	9?¼	98
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Fort Wayne	2,000,000	..	75	80
" Bonds	2,000,000	..	88	91
Hartford	750,000	25	..	145
Indianapolis	2,000,000	..	115	125
" Bonds, 6's	2 650,000	..	106	107
Jersey City	750,000	20	180	..
Lafayette Gas Co., Ind.	1,000,000	100	78	83
Bonds	1,000,000	1,000	90	91
Louisville	2,570,000	50	..	..
Laclede, St. Louis	7,500,000	100	51¼	51½
Preferred	2,500,000	100	90	92
Bonds	9,084,400	1,000	103	103¼
Montreal, Canada	2,000,000	100	200	..
Newark, N. J., Gas Co.	1,000,000	..	200	220
Bonds, 6's	4,000,000	..	128	130x
New Haven	1,000,000	25	253	..
Oakland, Cal.	2,000,000	..	53¼	54
" Bonds	750,000	..	..	..
Peoples G. L. & Coke Co., of Chicago	25,000,000	100	101⅝	101¾
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	20,100,00	1,000	..	108
2d "	2,500,000	1,000	104	105
Peoples, Jersey City	500,000	50	..	175
Rochester Gas & Elec. Co.	2,150,000	50	..	..
Preferred	2,150,000	50	83	..
Consolidated 5's	2,000,000	..	87½	90
San Francisco, Cal.	10,000,000	100	94	94½
St. Paul Gas Light Co.	1,500,000	100	49	51
1st Mortgage 6's	650,000	..	84	87
Extension, 6's	600,000	..	..	..
General Mortgage, 5's	2,400,000	.	88	90
Syracuse, N. Y.	2,500,000	25	17	18
Bonds	1,000 000	..	94	97
Washington, D. C	2,000,000	20	250	..
Western, Milwaukee	4,000,000	100	77	78¼
Bonds, 5's	3,556,000	.	100½	102
Wilmington, Del.	550,000	50	200	

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DIVIDEND NOTICE.

OFFICE OF WELSBACH COMMERCIAL COMPANY,
40 WALL ST., NEW YORK CITY, May 12, 1898

The Directors have this day declared a quarterly dividend of two (2) per cent. on the preferred stock, payable June 10, 1898, to stockholders of record at the close of business May 31, 1898. Transfer books of the preferred stock will be closed from June 1 to June 10, 1898, both inclusive. Checks will be mailed

1198-3 EDWARD C. LEE, Treasurer.

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As Gas Maker.

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1200-1 Address, "J. P. B.," care this Journal.

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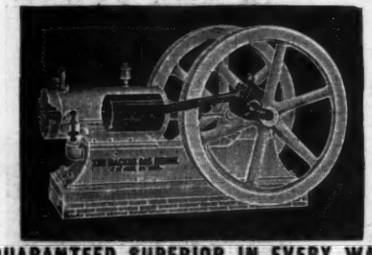

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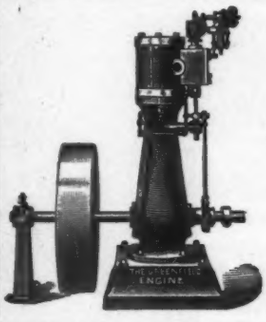

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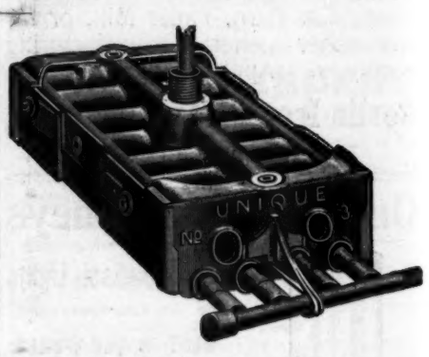

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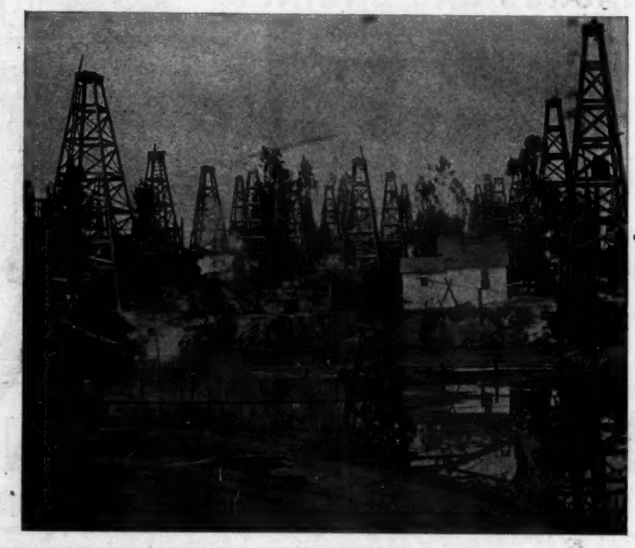

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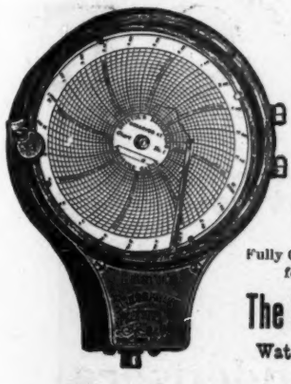

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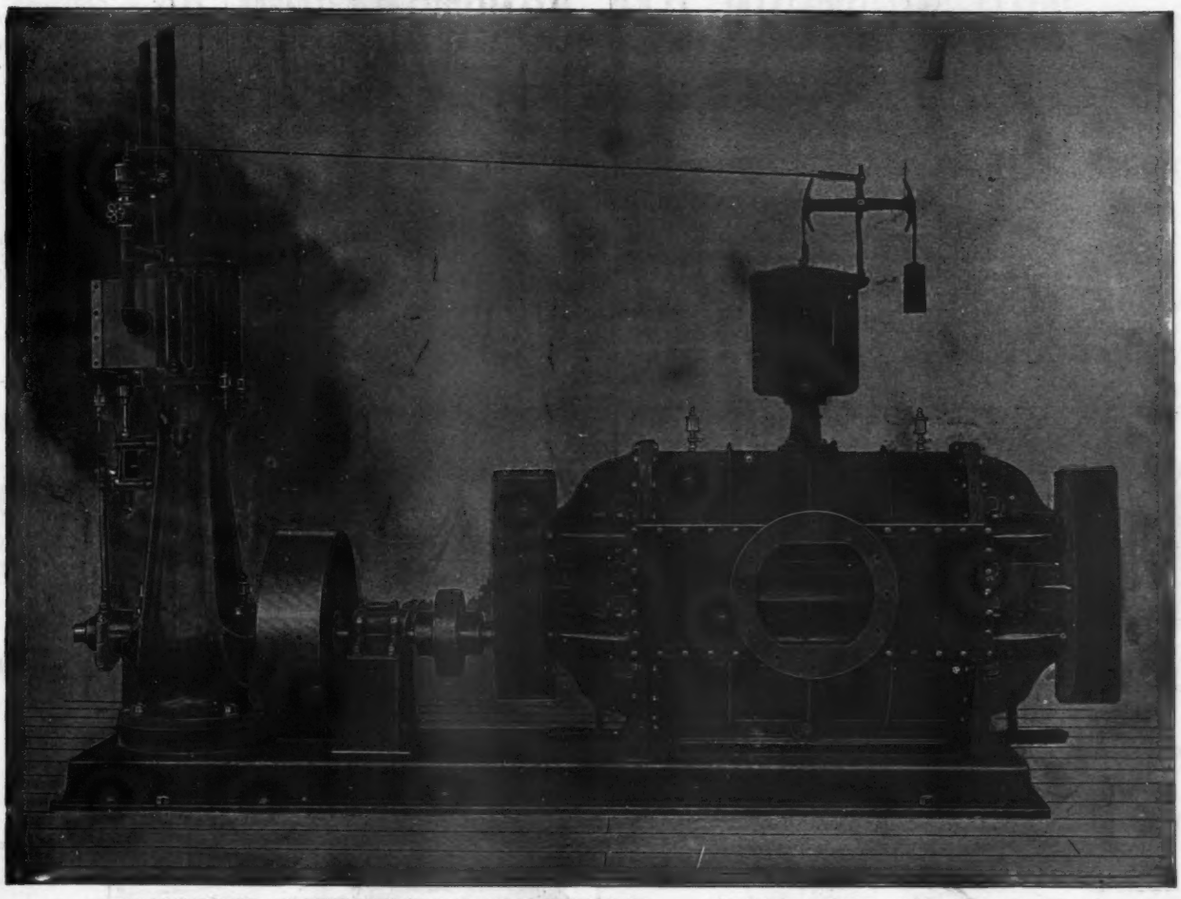

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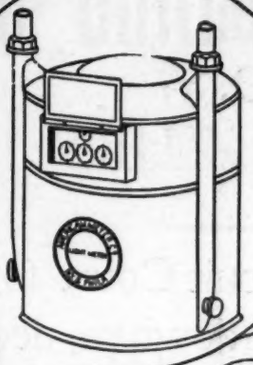

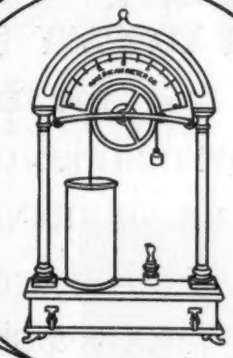

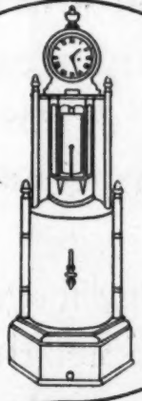

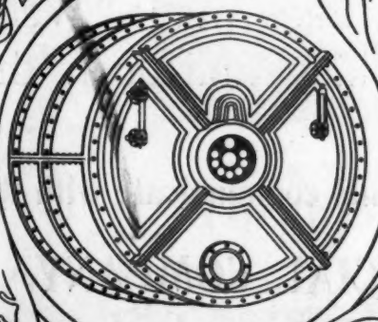

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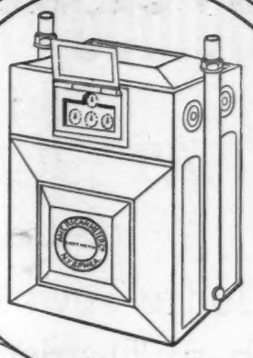

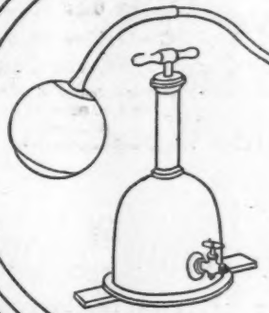

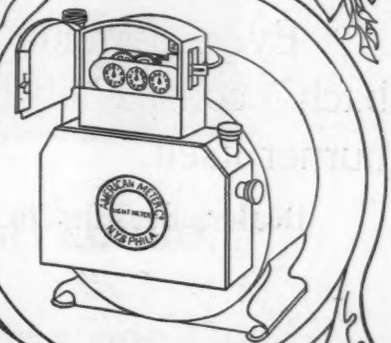

PUBLIC LIGHTING TABLE.

JUNE, 1898.

Day of Week.	Date.	Table No. 1. Following the Moon. Light.	Table No. 1. Following the Moon. Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Table No. 2. New York City. All Night Lighting. Extinguish.
				P.M.	A.M.
Wed.	1	1.30 AM	3.30 AM	7.15	3.15
Thu.	2	2.20	3.30	7.15	3.15
Fri.	3	No L.	No L.	7.15	3.15
Sat.	4	No L. PM	No L.	7.25	3.15
Sun.	5	No L.	No L.	7.25	3.15
Mon.	6	8.00 PM	10.50 PM	7.25	3.15
Tue.	7	8.00	11.30	7.25	3.15
Wed.	8	8.00	12.00	7.25	3.15
Thu.	9	8.00	12.30 AM	7.25	3.15
Fri.	10	8.00 LQ	1.00	7.25	3.15
Sat.	11	8.00	1.20	7.25	3.15
Sun.	12	8.00	1.50	7.25	3.15
Mon.	13	8.00	2.10	7.25	3.15
Tue.	14	8.00	2.40	7.25	3.15
Wed.	15	8.00	3.30	7.25	3.15
Thu.	16	8.00	3.30	7.25	3.15
Fri.	17	8.00	3.30	7.25	3.15
Sat.	18	8.00 NM	3.30	7.30	3.15
Sun.	19	8.00	3.30	7.30	3.15
Mon.	20	8.00	3.30	7.30	3.15
Tue.	21	8.00	3.30	7.30	3.15
Wed.	22	8.00	3.30	7.30	3.15
Thu.	23	9.10	3.30	7.30	3.15
Fri.	24	9.40	3.30	7.30	3.15
Sat.	25	10.00	3.30	7.30	3.15
Sun.	26	10.30 FQ	3.30	7.30	3.15
Mon.	27	10.50	3.30	7.30	3.15
Tue.	28	11.30	3.30	7.30	3.15
Wed.	29	12.00	3.30	7.30	3.15
Thu.	30	12.50 AM	3.30	7.30	3.15

TOTAL HOURS LIGHTING DURING 1898.

By Table No. 1.	Hrs.Min.	By Table No. 2.	Hrs.Min.
January	210.40	January	423.20
February	186.40	February	355.25
March	181.20	March	355.35
April	166.10	April	298.50
May	156.40	May	264.50
June	144.30	June	234.25
July	147.30	July	243.45
August	157.10	August	280.25
September	169.50	September	321.15
October	186.00	October	374.30
November	204.30	November	401.40
December	218.30	December	433.45
Total, yr.	2129.30	Total, yr.	3987.45

Welsbach Patent Sustained.

INJUNCTION GRANTED.

Judge Townsend, in the United States Circuit Court for the Southern District of New York, has handed down a decision sustaining the Welsbach Light Company's Rawson patent, and adjudged **THE SUNLIGHT INCANDESCENT GAS LIGHT COMPANY** to be an infringer. This Company has been enjoined from the further use of its method of manufacture of incandescent mantles or the sale or use of the same, and ordered to render an accounting.

A further decision has been handed down by Judge Lacombe in the United States Circuit Court, granting a motion for a similar injunction against **THE REX INCANDESCENT LIGHT COMPANY.**

Every other manufacturer of incandescent mantles in the United States is under these decisions an infringer of this patent, and the Welsbach Light Company will proceed against them at once.

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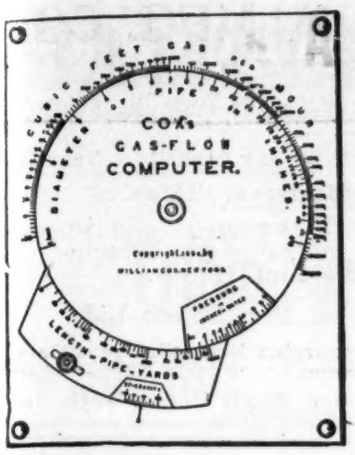

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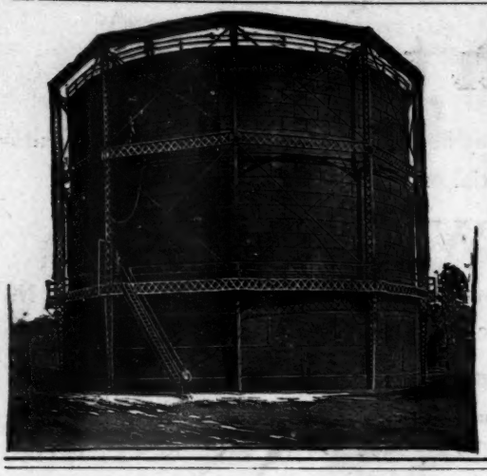

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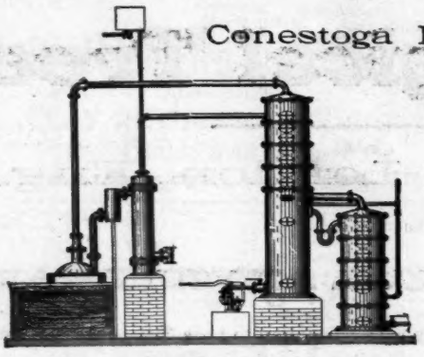

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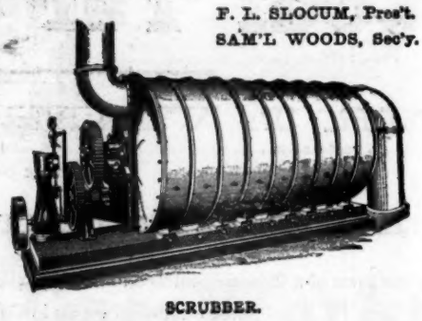

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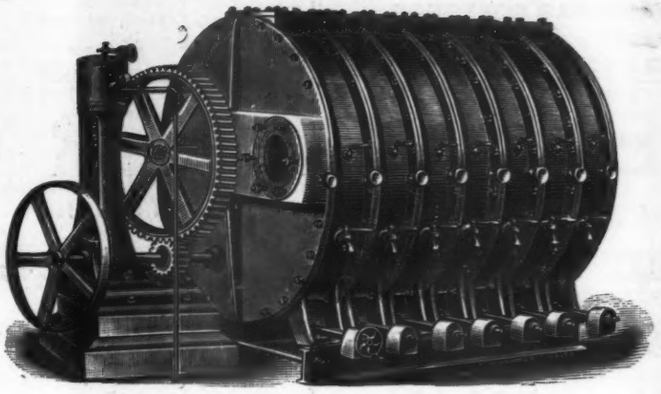

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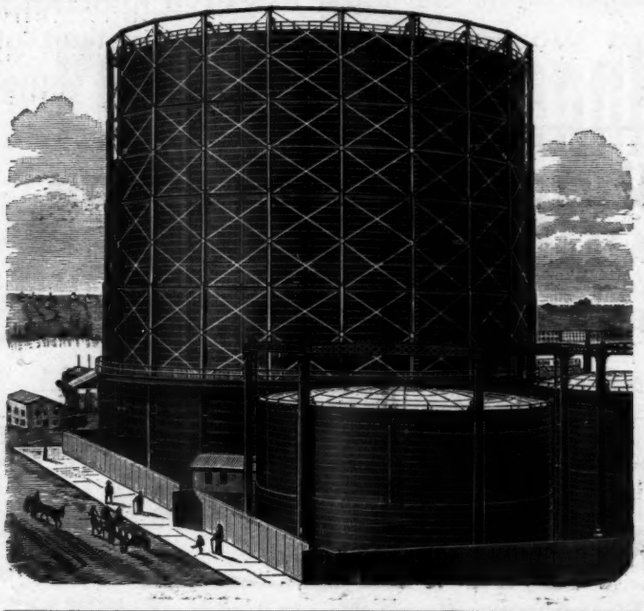

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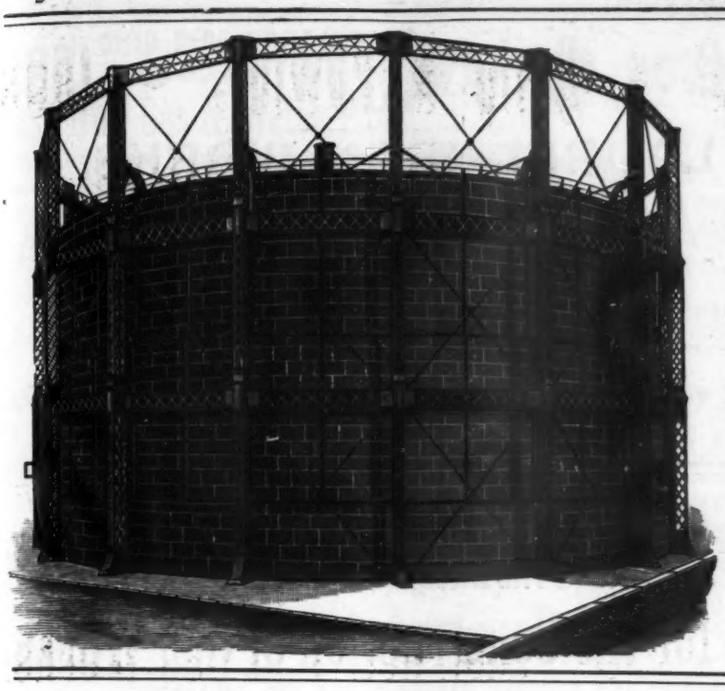

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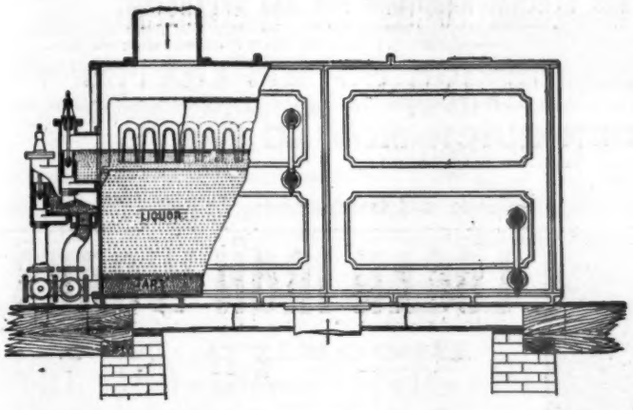

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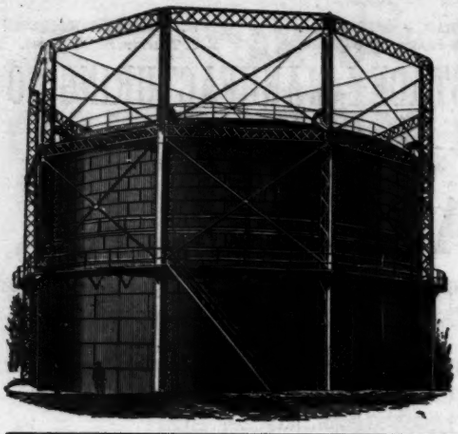

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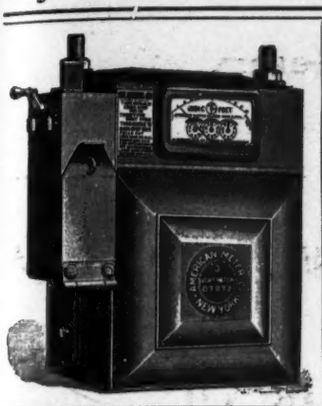

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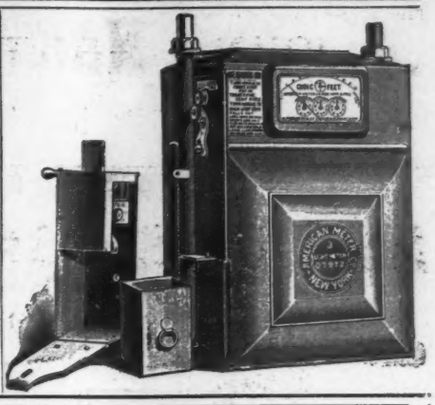

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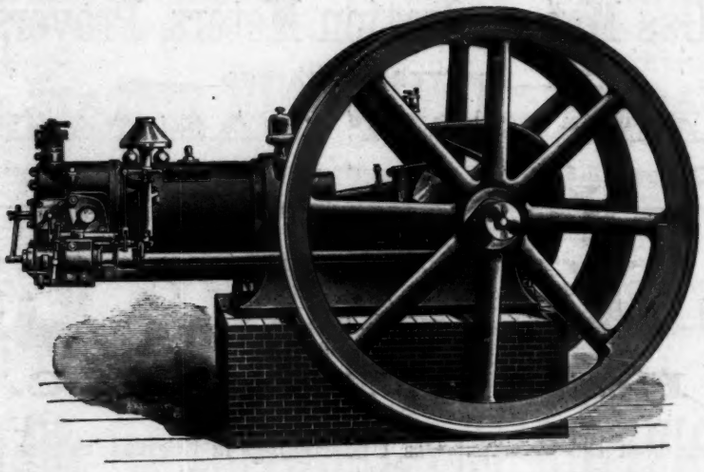

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